POTOMAC ECONOMICS

Memorandum

TO: NYISO

FROM: Pallas LeeVanSchaick and Joseph Coscia

DATE: October 3, 2024

RE: Comments on Modeling Improvements for Capacity Accreditation Firm Fuel Requirements

NYISO's August 29, 2024 ICAPWG presentation included a list of open questions related to implementation of capacity accreditation based on firm fuel status in winter as part of the Modeling Improvements for Capacity Accreditation (MICA) project.[1] The questions relate to criteria that NYISO will use to distinguish between firm, non-firm, and partially firm generators for accreditation purposes. These criteria are also relevant to the assumptions used by NYSRC in the IRM study. This memo provides our responses to the NYISO's questions.

A. Summary of Comments

We evaluate the MICA project's proposed 96-hour requirement for units with onsite fuel and proposed treatment of firm gas units and reach the following conclusions:

- *No analytical support for 96 hours* – The proposed 96-hour requirement is not based on any assessment of system needs.
- *96-hour requirement is excessive in the near term* – We analyzed winter reliability risk using the MMU's resource adequacy model considering historic firm fuel arrangements and oil inventories. We find that the appropriate length of the duration requirement for onsite fuel depends on the amount of firm gas contracting. Higher levels of firm gas contracting would reduce the length of time that would be appropriate for the duration requirement.
- *96-hour requirement would lead to over-estimate of winter risk in the IRM study* – We find that discounting the capacity of dual fuel generators that do not meet the 96-hour duration requirement for stored fuel would increase estimated winter reliability risk in the IRM study beyond the level that accurately reflects system needs.
- *If firm gas elections are not considered in the Available Gas profile of the IRM study, it will increase the IRM* – The current IRM modeling proposal would also discount nearly all capacity of gas-only generators in zones F-K, including those that demonstrate firm

[1] See August 29, 2024 ICAPWG presentation to Modeling Improvements for Capacity Accreditation", slide 12, available here.

transportation contracts in the accreditation process. This will further increase estimated winter risk in GE-MARS.

- If unaddressed, these issues will result in: (1) inflated IRM values, and (2) inefficiently low CAF values for non-firm and partial firm units.

Considering the above, we recommend the following:

- Consider generators' firm gas transport elections in the IRM study, so that the IRM and non-firm CAF values reflect the level of winter reliability risk resulting from investments to contract for firm fuel supplies; and
- Reduce the number of hours for the initial onsite fuel requirement and establish a process to update this value based on an annual assessment of winter energy adequacy risk to the NYISO system.

We also provide responses to NYISO's open questions related to the treatment of partial and additive fuel arrangements with illustrative examples in Section B.

B. Detailed Comments

Under the Modeling Improvements for Capacity Accreditation (MICA) project, the NYISO and the New York State Reliability Council (NYSRC) have developed proposed improvements to better reflect winter risk in the resource adequacy model and to accredit resources based on their marginal reliability value considering fuel limitations. These will provide incentives for resources to invest in fuel supply arrangements that enhance reliability. The proposed rules relate to the estimation of CAFs for firm and non-firm CARCs and improvements to modeling of winter risk in GE-MARS in NYSRC's IRM study process. We refer to these proposals together here as the "current proposal". NYSRC has relied upon the duration requirements proposed by NYISO in the MICA process to develop its modeling proposal, and the accreditation rules normally depend on the resource adequacy modeling assumptions.

Below, we address the "open questions" on firm requirements raised by NYISO in its August 29, 2024 MICA presentation:

1. Based on system needs, is 96-hours the appropriate duration requirement for units with onsite fuel?

The appropriate duration requirement for units with onsite fuel depends on the system's level of energy adequacy risk. Energy adequacy refers to the ability of system resources to supply enough energy to meet load over a prolonged period (e.g. days or weeks). By contrast, traditional resource adequacy assessments generally focus on the ability of system resources to meet peak needs of much shorter duration. Maintaining sufficient stored fuel inventories to last through a severe winter cold wave is a potential energy adequacy challenge for the NYISO system.

NYISO does not directly model energy adequacy risk in its IRM and LCR studies. This is because NYISO's GE-MARS software does not track depletion of stored fuel inventories over

time for oil and dual fuel units. Instead, NYISO's current proposal aims to indirectly capture energy adequacy risk by discounting the modeled capacity of dual fuel units that elect to maintain less than 96 hours of fuel. Thus, a 100 MW generator with 72 hours of fuel would be modeled as a 75 MW generator since it has 75 percent of the required fuel availability. This "ICAP Discount" approach increases the estimated risk during winter peak load hours in GE-MARS.

The ICAP Discount approach is appropriate if the resulting winter risk in MARS is consistent with the system's level of energy adequacy risk. However, the current proposal may inaccurately assess winter reliability risk for two reasons:

- The proposal to discount the modeled capacity of dual fuel generators based on duration requirements is appropriate only if it produces results that are consistent with the results that a direct model of energy adequacy risk would produce. For example, suppose dual fuel generators have an average availability of 15 GW UCAP before any fuel storage requirements are considered. If depletion of stored oil inventories is not a material concern, it would be realistic to model 15 GW of average availability from these units. However, if the proposed duration requirements result in modeling only 12 GW of average availability, the model may produce an unrealistically high level of winter risk. Hence, the duration requirements must be based on an assessment of the system's energy adequacy needs in order to produce appropriate results.
- The proposal would model nearly all capacity of gas-only generators in zones F-K as unavailable, including generators that demonstrate firm transportation contracts in the accreditation process. For example, the proposal assumes only 375 MW of output from the approximately 7 GW of gas-only generators in zones F-K is available at the highest winter load levels. If a larger amount of capacity elects the Firm CARC and demonstrates firm gas transportation contracts (as is indicated in recent generator fuel surveys), this 375 MW availability will not be increased under the current proposal, which will tend to inflate the winter LOLE estimates and the IRM.[2]

Since MARS is not currently configured to model fuel inventories necessary to evaluate energy adequacy needs, we assessed the appropriateness of the proposed 96-hour onsite fuel requirement using PE-RAM, Potomac Economics' resource adequacy model. PE-RAM simulates 8,760 hours for an array of replication years considering generator forced outages, intermittent profiles, load profiles and uncertainty, transmission limits, and utilization of energy-limited resources. Appendix A to this memo summarizes assumptions from our PE-RAM study. PE-RAM calculates the total Expected Unserved Energy (EUE) for a given system. PE-RAM is configured to use either the ICAP Discount approach or a Model Oil Inventories approach which explicitly models the depletion of onsite fuel inventories, allowing us to compare how the EUE metric is affected by the approach to modeling fuel inventories.

[2] See April 3, 2024 presentation to NYSRC Installed Capacity Subcommittee "Gas Constraints Whitepaper Update", slide 8, available here.

We used PE-RAM to calculate system reserve margin requirements for 2025/26, 2027/28 and 2030/31 using the ICAP Discounting approach for the following cases:[3]

- "Current Proposal" (Case 1): all gas-only units are modeled as non-firm; oil and dual fuel units derated based on 96-hour requirement;
- "Firm Gas" (Case 2): only gas-only units without firm transport contracts are modeled as non-firm; oil and dual fuel units are derated based on 96 hours requirement;
- "Firm Gas + 72 Hour" and "Firm Gas + 48 Hour" (Cases 3 and 4): only gas-only units without firm transport contracts are modeled as non-firm; oil and dual fuel units are derated based on 72 or 48 hour requirements; and
- "50% Firm Gas + 72 Hour" and "50% Firm Gas + 48 Hour" (Cases 5 and 6): Assume 50 percent reduction in the share of gas-only generation with firm transport contracts compared to the "Firm Gas + 72 Hour" and "Firm Gas + 48 Hour" cases.

After adjusting the system to meet the target EUE criteria in each scenario using the ICAP Discounting approach, we re-calculated total EUE using a "Model Oil Inventories" approach. The Model Oil Inventories approach models oil and dual fuel units with no duration-based reductions to their installed capacity, but instead models each facility's hourly remaining stored fuel inventory directly. In this approach, oil and dual fuel units become unavailable if their fuel inventories reach zero (or if experiencing a forced outage). We modeled initial fuel inventories and lead times for replenishment based on recent generator fuel surveys. We conservatively doubled the refueling lead times indicated in the generator surveys to capture potential delays during a severe cold weather event.

The following tables summarize the results of our analysis using PE-RAM. For each capability year and case, the first table reports the IRM estimated using PE-RAM's ICAP Discount approach, and the second table reports the associated percentage of EUE taking place in winter and non-firm CAF value. It is important to note that these results are not outputs of GE-MARS and are intended to indicate only the direction and approximate magnitude of impacts. The MWh of EUE estimates are provided in the third table using the ICAP Discount approach and the Model Oil Inventories approach.

IRM Estimates Using PE-RAM's ICAP Discount Approach

Case	Model firm gas contacts?	Derate Oil/Dual with less than:	Estimated PE-RAM IRM 2025	2027	2030	Change from Current Proposal 2025	2027	2030
1	No	96 hours	124.2%	127.2%	138.3%			
2	Yes	96 hours	124.0%	126.0%	136.9%	-0.2%	-1.1%	-1.5%
3	Yes	72 hours	123.8%	125.7%	135.6%	-0.4%	-1.5%	-2.7%
4	Yes	48 hours	123.8%	125.6%	134.8%	-0.4%	-1.6%	-3.5%
5	Half	72 hours	124.0%	126.5%	137.7%	-0.2%	-0.6%	-0.6%
6	Half	48 hours	124.0%	126.0%	136.2%	-0.2%	-1.1%	-2.1%

[3] We calculate reserve margin requirements by removing surplus capacity until reaching a target EUE of 200 MWh/year. This level of EUE risk corresponds to the 0.1 LOLE criteria in recent NYSRC IRM studies.

Winter Risk and Non-Firm CAF Estimates Using PE-RAM's ICAP Discount Approach

Case	Model firm gas contacts?	Derate Oil/Dual with less than:	Percentage of EUE in Winter			Non-Firm CAF		
			2025	2027	2030	2025	2027	2030
1	No	96 hours	13%	39%	74%	87%	61%	26%
2	Yes	96 hours	2%	18%	51%	98%	82%	49%
3	Yes	72 hours	1%	8%	31%	99%	92%	69%
4	Yes	48 hours	0%	3%	15%	100%	97%	85%
5	Half	72 hours	4%	28%	64%	96%	72%	36%
6	Half	48 hours	2%	14%	43%	98%	86%	57%

EUE Estimates at IRM Using PE-RAM: ICAP Discount v Model Oil Inventories Approach

Case	Model firm gas contacts?	Derate Oil/Dual with less than:	Winter EUE at IRM (MWh) ICAP Discount Approach			Winter EUE at IRM (MWh) Model Oil Inventories Approach		
			2025	2027	2030	2025	2027	2030
1	No	96 hours	26	77	150			
2	Yes	96 hours	4	37	101	0	1	4
3	Yes	72 hours	1	16	62	0	1	13
4	Yes	48 hours	0	7	30	0	1	37
5	Half	72 hours	7	56	131	0	51	68
6	Half	48 hours	3	29	88	0	82	478

The results indicate the following:

- Under the Current Proposal, the proportion of modeled winter risk when the system is at its target reserve margin rises from 13 percent in 2025/26 to 74 percent by 2030/31. (see first table Case 1)
- Modeling firm gas elections based on recent generator fuel surveys reduces the share of winter risk and IRM and results in higher non-firm CAFs. (see first and second tables, Case 1 vs 2-4)
- For cases with firm gas modeling at current levels, the 48-hour firm fuel requirement produced results that were most consistent between the two approaches in all years. (see third table, Case 4) This case resulted in IRM values that were lower by 0.4 percent (2025), 1.6 percent (2027) and 3.5 percent (2030) compared to the Current Proposal case. (see first table, Case 1 vs 4) They also resulted in much lower percentages of winter EUE and much higher non-firm CAFs. (see second table, Case 1 vs 4)
- For cases with firm gas modeling at 50 percent of current levels, a 72-hour firm fuel requirement (Case 5) produced results that were most consistent between the two approaches in 2027. (see third table, Case 5) However, in 2030, the EUE was lower in the Model Oil Inventories approach, indicating that a firm fuel requirement between 48 and 72 hours would be appropriate if firm gas contracting declines 50 percent from current levels. (see third table, Cases 5 & 6)

- For purposes of comparison, NYSRC's latest sensitivity analysis for the 2025/26 capability year showed a 0.9 percent impact on the IRM and 8 percent proportion of winter LOLE risk as a result of modeling the proposed gas and dual fuel limitations.[4] PE-RAM produced a similar result (13 percent) for the corresponding case (see first table, Case 1 in 2025/26).

These results suggest that the proposed 96-hour requirement is unnecessarily strict over the next few years, although the appropriate level will increase over time and if the amount of firm gas contracting falls from current levels. Hence, we recommend the following:

- Consider generators' firm gas transport elections in the IRM study, so that the IRM and non-firm CAF values reflect the level of winter reliability risk resulting from investments to contract for firm fuel supplies; and
- Reduce the number of hours for the initial onsite fuel requirement and establish a process to update this value based on an annual assessment of winter energy adequacy risk to the NYISO system.

2. How should gas-only units with less that 24 hours of contract coverage be treated?

Gas-only units with less than 24 hours of contract coverage should be valued based on their ability to reliably operate to meet winter peak demand. Generators typically have limited flexibility to utilize a higher proportion of their maximum daily quantity (MDQ) of gas during critical hours for power system reliability because of the physical limits of gas pipelines. When operational flow orders are imposed by gas pipeline operators, the aggregate supply of gas to electric generators is neither fully ratable nor fully flexible. This dynamic should be reflected in the resource adequacy modeling and accreditation assumptions (unless a particular generator provides contract documents that demonstrate otherwise). The following is a recommended approach:

- NYISO establishes a generic hourly gas utilization profile based on historic generator gas consumption in each hour of the day on very cold winter days. This profile is representative of the average amount of flexibility across gas generators. The figure below shows an example of such a profile. The illustrative profile is calculated as average gas-fired generation output in zones F-K in each hour, relative to maximum output for the day, for the 15 coldest days of the 2017-2022 winters when the gas pipelines were most constrained.
- Generators are able to elect a quantity of firm MWs by applying their heat rate curve and the shape determined in the previous step to their MDQ of gas contract coverage. The resulting average capacity factor of the unit during the winter peak load window,

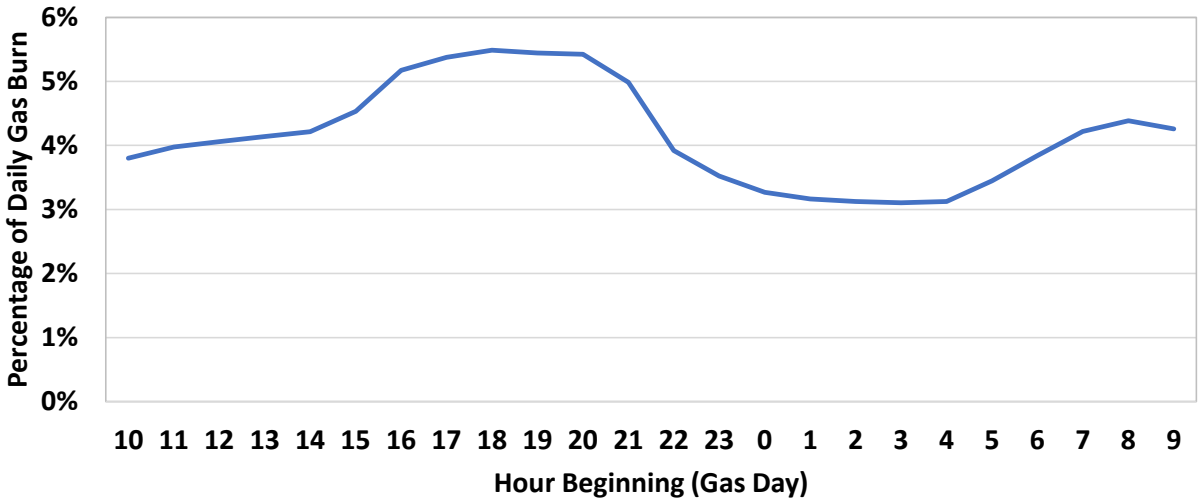
[4] See September 4, 2024 presentation to NYSRC Installed Capacity Subcommittee "Fuel Availability Constraints Modeling: 2025-2026 IRM Preliminary Base Case Sensitivity", slide 5-6, available here.

multiplied by the unit's installed capacity, determines the maximum firm MW it may elect. [5]

- An equivalent quantity of gas generation availability should be modeled in the IRM study using the generic hourly shape, for purposes of determining the IRM/LCRs and non-firm CAF value.

Examples of the recommended treatment are provided below in response to the next question.

Figure 1: Profile Based on Average Zone F-K Historical Gas Generation



3. How should partial-firm MWs be calculated?

Generators with enough firm gas transportation to qualify only part of their installed capacity as firm should earn the weighted average of the firm and non-firm CAFs. The unit's firm MWs can be calculated based on the approach outlined above, using a model that converts hourly fuel consumption to output. Below are two examples:

- Example 1: a gas-only generator with 100 MW winter ICAP, a heat rate of 7.0 MMBTU/MWh, and a firm gas transport contract with max daily quantity (MDQ) of 8,400 MMBTU (equivalent to a 50 percent average capacity factor). By apportioning this unit's MDQ over 24 hours using the illustrative profile above, the average output in the peak load window (hours beginning 16 through 21) is 64 MW. This would determine the unit's firm MWs.
- Example 2: a gas-only generator with 100 MW winter ICAP, a heat rate of 7.0 MMBTU/MWh, and a firm gas transport contract with max daily quantity (MDQ) of 12,600 MMBTU (equivalent to a 75 percent average capacity factor). By apportioning this unit's MDQ over 24 hours using the illustrative profile above, the average output in

[5] For example, a unit with a heat rate of 7.5 MMbtu/MWh, an upper operating limit of 100 MW, an MDQ = 12000 MMbtu, and 5.2 percent hourly share of daily burn in hour 16 based on the profile would have a potential firm capacity in hour 16 MW of 83.2 MW = 12000 MMbtu/day × 0.052 day/hour ÷ 7.5 MMbtu/MWh. This calculation would be repeated for hours 17 to 21 to determine the average from 16 to 21.

the peak load window (hours beginning 16 through 21) is 96 MW. This would determine the unit's firm MWs.

- Example 3: a gas-only generator with 100 MW winter ICAP, an MDQ of 12,600 MMBTU, a duct-firing upper range of 10 MW with a heat rate of 10 MMBTU/MWh, and a heat rate of 7 MMBTU/MWh at other output levels. In this example, the unit's firm MW is reduced to 94 MW due to the higher heat rate of its upper 10 MW. More detailed heat rate curves could also be taken into account in this way.

4. How should additive arrangements (gas + dual fuel) contribute to firm/partial-firm elections?

When determining a unit's firm MWs, the NYISO should consider its combined maximum output as well as its ability to meet the duration requirement. Some units are capable of burning a mix of gas and liquid fuels while operating. For this type of unit, it is appropriate to add the equivalent MWHs provided by each fuel source (e.g. stored liquid fuels plus gas transport contracts quantities) when determining its total fuel relative to the duration requirement.

Some units cannot simultaneously burn gas and liquid fuels. In these cases, gas transport contracts may still be additive to oil-fired capability because the owner would be able to sell its gas transport rights to another unit in the NYCA while operating on oil. In such cases, gas transport contracts and stored fuels can added when determining total fuel relative to the duration requirement. However, it will be necessary to establish provisions and a reporting structure that prohibit generators from selling or transferring firm gas transport rights backing a firm fuel election to an entity other than another non-firm gas NYCA generator.

Appendix A: Summary of Assumptions Used in PE-RAM Analysis

Potomac Economics' Resource Adequacy Model (PE-RAM) is a program designed to evaluate the impacts of market design proposals related to resource adequacy. It is an hourly chronological model that considers load forecast uncertainty, generator outages, transmission limitations, intermittent resource profiles, and energy storage limitations. PE-RAM simulates a set of 8,760-hour replication years with variations in key inputs (such as generator outages and load forecast uncertainty) and calculates Expected Unserved Energy (EUE).

PE-RAM is not designed to replicate outcomes of other programs such as GE MARS and is not used to perform absolute assessments of the NYISO system's reliability. Instead, it is designed to allow flexible changes to modeling rules and assumptions for use in examining the impact of market design changes.

The table below summarizes inputs used in the PE-RAM modeling described in this memo:

Assumption	Description
Load Forecast	2024 Gold Book

Load Forecast Uncertainty	Modeled higher load forecast levels and associated probabilities based on bins 1-3 from 2023/24 IRM Study
Hourly Load Model	Summer: 2013 load profile for bins 1 and 2, 2018 load profile for Bin 3, scaled to match Gold Book load forecast Winter: 2017/18 winter load profile used for all bins. Total energy across period December 27 – January 8 scaled to align with probability of LFU bin, based on historic distribution of maximum winter two-week energy demand relative to winter peak forecast
Existing Generation Capacity	Based on 2024 Gold Book 2027: Gowanus 2&3 and Narrows peakers cease operating during ozone season (May-Sep) 2030: 410 MW NYPA peakers in NYC retired
New Generation Capacity *(cumulative totals shown)*	2025: ~400 MW UPV 2027: ~900 MW UPV, 1,740 MW OSW 2030: ~3,500 MW UPV, ~1,500 MW LBW, 1,740 MW OSW, 2,000 MW 4-hour battery
Behind-the-meter Solar	2024 Gold Book. Nameplate values: 6.7 GW (2025), 8.4 GW (2027), 10.0 GW (2030) BTM solar modeled as resource with hourly shape
Intermittent Generator Shapes	8760 hourly capacity factors aligned with load profile year for each bin, based on historic data provided by DNV to NYISO
Zonal Topology	Includes A, BCE, D, F, G, HI, J and K zones
Transmission Limits	Based on transmission limits after completion of AC PPTN projects from NYISO 2022 RNA MARS topology. 2030: included upgrades based on estimated MARS limit impact of Long Island PPTN projects from the Long Island PPTN study
New HVDC Transmission	2027: CHPE modeled in-service with 1,250 MW sales in NYC in summer and 0 MW sales in winter 2030: Clean Path NY modeled in-service with 1,300 MW transfer capability between BCE and NYC zones
Imports	Informed by 2024 NYSRC ICS EA white paper and existing UDRs: Bin1: 1,975 MW, Bin 2: 2,975 MW, Bin 3: 4,475 MW
Non-Firm Gas	Historical relationship between non-firm gas availability and daily winter peak load.
Firm Gas	Generators with firm gas transportation modeled without fuel limitations based on recent NYISO winter fuel surveys
Oil Inventory Modeling	Starting seasonal inventories and replenishment timeframes based on recent NYISO winter fuel surveys. Replenishment lead times indicated in surveys doubled during two-week winter cold wave event.
SCRs	2024 Gold Book (1,281 MW summer, 1,005 MW winter)