Gas Constraints Whitepaper Update

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NYISO

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Agenda

- Resource Adequacy Modeling Consideration
- Initial Gas Constraint Model Test
- Next Steps
- Appendix

Modeling vs. Markets Clarification

- **The Resource Adequacy (RA) model is the basis for the capacity requirements as well as capacity accreditation of the NYISO's ICAP market. Consistency between the RA model and the market structure is desired**
  - NYISO's RA team has been in close collaboration with the Market Design team to ensure efforts to reflect gas constraints in both the RA model and the markets are coordinated
- **However, the RA model will not be able to simulate the exact market reality, due to its probabilistic nature and modeling limitations. Therefore, considerations for RA modeling improvements focus on capturing relevant RA impacts and facilitating subsequent market processes (i.e., Capacity Accreditation calculations)**
  - The aspects of relevant RA impact includes time period, location (zonal), magnitude (MW) and triggering conditions for gas constraints (using load level as a proxy for conditions giving rise to the potential for gas constraints)
- **The initial gas constraint model aims to ensure an appropriate modeling construct is included in the RA model, and the inputs to the gas constraint assumptions can be updated based on experience and generator fuel availability decisions (i.e., firm vs. non-firm fuel optionality)**

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Outage Double Counting

- Currently, the IRM model uses generator Equivalent Demand Forced Outage Rate (EFORd) based on 5 years of historical data from the Generating Availability Data System (GADS)
- Lack of fuel events that are reported in GADS by generators are captured in the EFORd, however the cause code for lack of fuel has historically been submitted infrequently
  - The NYISO compared historical GADS data and operational reports and concluded that the current GADS data does not fully capture gas constraints
- While the risk of double counting lack of gas in modeling EFORd and gas constraints appears low based on historical data reporting, the NYISO is proceeding with testing possible updates to the GADS data processing tools to exclude the reported lack of fuel during winter to avoid potential double counting
  - More details will be reported when progress is made with the development work

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Modeling Availability vs. Unavailability

- **The NYISO had previously considered two major modeling approaches for gas constraints in the RA model:**
  - Modeling Availability
    - Gas constraints are modeled as maximum MW assumed as available in a location when the condition is triggered
    - Example: In Zone 1, total gas generation is 1,500 MW. The maximum output from a group of units in Zone 1 is 1,000 MW when NYCA load is above 25,000 MW during the months of December, January, and February
  - Modeling Unavailability
    - Gas constraints are modeled as MW assumed to become unavailable in a location when the condition is triggered
    - Example: In Zone 1, total gas generation is 1,500 MW. A reduction of 500 MW of available capacity in Zone 1 will be triggered when NYCA load is above 25,000 MW during the months of December, January, and February. The capacity reduction can be achieved by either derating a group of units in Zone 1, or adding a negative unit to Zone 1
- **In GE MARS, generators are also subject to the modeling of forced outages. Under either of the modeling approaches, dynamically applying the gas constraint with consideration of unit forced outages is ideal**
  - For example, the maximum output of 1,000 MW from the unit group in Zone 1, or the reduction of 500 MW in available capacity in Zone 1, is after forced outages on units are considered
- **However, GE MARS currently does not have capability to capture correlated/shared constraints or derates. Therefore, either approach would require some compromise in order to be feasible with the current structure**
  - Dynamically applying the gas constraint (availability or unavailability) with consideration of unit forced outages will require significant modeling changes to the underlying GE MARS program

Modeling Availability

- **The availability approach appears to align naturally with the effect of gas constraints that limit the amount of available fuel, but could introduce significant changes to the underlying database**
- **One option for modeling availability is through aggregation**
  - This means that the existing fleet will be aggregated to a single unit, and subject the unit to the output constraints to represent availability of gas under triggering conditions
  - ISO-NE planned to adopt the Aggregated Gas Model in their RA study (further described below) but later found it to not be feasible (*ISONE Methodology*)
    - During December, January, and February, the existing thermal fleet will be removed
    - Two new units will be added, one with a fixed output profile and one as a storage unit
      - The unit with a fixed output profile represents available pipeline gas. The hourly profile is based on daily gas volume forecast and is converted into hourly profile based on historical hourly gas burned for a typical day
      - The storage unit represents available LNG based on a seasonal forecast. The ELR functionality is utilized
    - A topology limit is also implemented to represent total gas capacity available behind the gas pipeline
- **Another option to model availability is through a topology construct via “dummy bubbles”**
  - This means that a dummy zone will be added inside all the existing zones subject to gas constraints. Affected units will be modeled inside the applicable dummy zone, which will have transfer limitations to the parent zone, representing the gas constraints
  - The NYISO did explore and test this option as part of the screening of modeling concepts as discussed in later slides

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Modeling Unavailability

- **The unavailability approach aligns with the existing GE MARS construct in modeling generator derates and outages, but may have precision issues due to overlapping with the unit forced outages**
- **One option for modeling unavailability is to use the existing construct to derate individual units**
  - GE MARS has an existing construct to reflect temperature derates of combined cycle units. This is done through dynamically applying derates on selected units under certain load conditions.
    - This is part of the existing IRM study model.
  - The same construct can be utilized for gas constraints to derate units within a location when certain load conditions occur during winter
- **Another option to model unavailability is to add a negative unit to represent a capacity reduction in certain locations**
  - The negative unit can be modeled as pre-determined reduction profiles during winter
    - This was the modeling approach taken in the Sensitivity Case #7 on this year's PBC, which applies the capacity reduction for all hours during the months of January, February, and December
  - The negative unit can also be triggered by certain load conditions during winter

Proceeding with Modeling Unavailability

- **NYISO has reviewed both approaches with GE and is pursuing the unavailability approach at this point, with a longer-term plan to address the outage/constraints overlapping issue**
  - The longer-term solution can include introduction of correlated constraints in GE MARS to capture the limitation of available MW on top of unit forced outages
  - The unavailability approach offers simplicity in modeling construct development in the near term, as well as the flexibility to consider modeling LFU bin-specific constraints
  - The benefits of the availability approach can also be realized when the overlapping issue is addressed
    - Testing has been conducted to quantify the impact of overlapping issue as discussed in later slides
  - Aggregated unit modeling was reviewed, and the following issues have been identified:
    - This is a significant change to the underlying IRM database.
    - It requires critical inputs such as unit forced outage rate and performance to develop the modeling for the aggregated unit. Some of the inputs may not be available in the near-term
    - It also adds to modeling complications if LFU bin-specific constraints are considered

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Gas Constraint Modeling: Initial Characteristics

- **Gas constraints are to be applied to certain thermal units in Zones F – K**
  - As illustrated by the Market Monitoring Unit (MMU), pipeline bottlenecks currently impact southeast NY most significantly
    https://www.nyiso.com/documents/20142/33916814/MMU%20Gas%20Availability%20Presentation__20221020.pdf/bf599ef4-eb0f-a436-8b1c-33eb129319fc
  - Gas constraints will not initially be applied to units in Zones A – E at this point
    - Existing studies have not shown the current prevalence of significant gas constraints in Zone A - E
    - Gas constraints can be applied to Zone A – E if needs are identified in the future
- **Gas constraints are to be applied in December, January, and February**
  - Winter cold weather conditions are most likely to occur during these months
- **Load level will be used as a proxy for temperature to trigger the gas constraint in the model**
  - Demand for gas is closely related to temperature during winter
- **Different magnitude levels of gas constraints are to be applied to represent different winter weather scenarios across the different LFU bins in the model**
  - This is to represent different gas constraints effects due to different weather conditions

These characteristics should be revised and updated as new information becomes available

Initial Gas Constraint Model

- **The NYISO previously screened 4 different concepts for the gas constraints model, with the combinations of modeling constructs and triggering condition options (more details in Appendix)**
  - The screening considered aspects such as feasibility in GE MARS, flexibility to trigger different levels of constraints under different weather conditions, ability to account for unit forced outages and whether the modeling would have undesired outcomes such as impacting base case results
- **Based on the screening, the NYISO concluded that**
  - The negative EOP step should not be considered due to its inflexibility
  - Modeling availability with topology construct would significantly change the underlying database and change the base case results
  - Modeling unavailability with load level triggering conditions offers a viable near-term approach to capture the gas constraints characteristics
- **The NYISO proceeded to further develop the gas constraint model with the following configuration options:**
  - Gas Constraint modeling implementation: existing unit derate vs. negative unit

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Initial Gas Constraint Inputs

- **The NYISO has considered a six-tiered gas constraint model:**
  - Tier 1 = extreme winter load level = maximum gas constraints
  - Tier 2 = cold winter load level = significant gas constraints
  - Tiers 3 - 5 = tight winter load level = some gas constraints
  - Tier 6 = normal winter load level = minimal to no gas constraints
- **With input from MMU, the NYISO determined constraint magnitudes based on daily peak load level using historical production data and EPA fuel data to estimate gas production in Zones F – K**
- **The load conditions below are based on historical winter data and will be reviewed in future IRM cycles as system conditions change and winter load levels increase**

Tier	Corresponding NYCA Load Conditions	Constraint Magnitude
1	≥ 25,500 MW	~6,500 MW
2	25,000 – 25,500 MW	5,500 MW (85% of Tier 1)
3	23,500 – 25,000 MW	3,500 MW (54% of Tier 1)
4	23,000 – 23,500 MW	2,000 MW (31% of Tier 1)
5	22,000 – 23,000 MW	1,000 MW (8% of Tier 1)
6	<22,000 MW	0 MW (No Derate)

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Initial Gas Constraint Inputs (cont.)

- **Based on the defined load levels, the NYISO counted the relevant dates for each tier when the gas constraints would be triggered for each LFU bin in the current study**
  - The relevant days are used to develop the dummy profile to trigger gas constraints on an hourly basis
  - The relevant day is counted if the daily peak load meets the defined condition. The dates are used to trigger gas constraints for the day
    - Applying gas constraints for Bins 5 -7 (< 50/50 peak load condition) is not expected to impact the modeling results and, therefore, the NYISO is only considering gas constraints for Bins 1 - 4 at this point

Tier	NYCA Load Conditions	Constraint Magnitude	Bin 1	Bin 2	Bin 3	Bin 4
1	≥ 25,500 MW	~6,500 MW	16	6	3	1
2	25,000 – 25,500 MW	5,500 MW (85% of Tier 1)	11	7	2	0
3	23,500 – 25,000 MW	3,500 MW (54% of Tier 1)	40	28	7	6
4	23,000 – 23,500 MW	2,000 MW (31% of Tier 1)	8	19	10	4
5	22,000 – 23,000 MW	1,000 MW (8% of Tier 1)	11	16	21	17

- **The NYISO also tested the two gas constraint implementation options of negative unit and existing units derate, with the existing unit derate amount being consistent with the size of the negative unit**

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Initial Gas Constraint Model Test Results

- Gas constraint overlapping with forced outage modeling was identified, but currently does not appear to have a significant impact (negative capacity vs. existing unit derate)
- The preferred modeling methodology of derating existing units has no impact on the base case IRM under the initial gas constraint magnitude and load level trigger assumptions

Case	Shift	IRM	J LCR	K LCR	G - J
Base Case: Sensitivity 6a	Tan45	23.04%	72.40%	109.52%	84.02%
Sensitivity 7a-2: 7,000 MW Perfect Capacity Removed	Parametric A – K Shift	23.09%	72.44%	109.57%	84.06%
Existing Unit Derate Based on Magnitude Levels	Parametric A – K Shift	23.04%	72.40%	109.52%	84.02%
Negative Capacity Based on Magnitude Levels	Parametric A – K Shift	23.06%	72.40%	109.54%	84.03%

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Modeling Alignment with Markets

- **The NYISO has considered the impact of modeling winter gas constraints based on the current proposal for fuel availability Capacity Accreditation Resource Class (CARC) elections (i.e., firm vs. non-firm), which could fluctuate year-to-year in the near-term**
  - Over time as the markets continue to evolve, CARC elections are expected to stabilize to reflect the fuel risks. But in the short term, as the markets are adapting to the new rules, the elections could potentially over- or understate the real gas constraint risks
- **The NYISO tested an extreme test case with the capacity of all thermal units in Zones F – K not available for just the peak hour in LFU Bin 1. This case shows LOLE increased from 0.100 to 0.106**
  - For the test, the NYISO derated all gas/dual fuel units in Zones F – K (~21,500 MW of modeled capacity) to 0 MW for one hour in Bin 1, without any other winter restrictions
  - This extreme case could represent a scenario where all thermal units opt to elect non-firm status.
- **Additional processes to handle the IRM study assumptions can be considered to address these potential risks**
  - For example, sensitivity cases could be run ahead of CARC elections with different potential non-firm election levels to provide transparent information to the markets

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Next Steps

- **The NYISO will bring this presentation to the 11/17 ICAP Working Group to solicit inputs from broader stakeholders**
- **The NYISO will continue testing the current modeling constructs based on inputs received from the ICS and ICAP Working Group, and plans to return to the 11/28 ICS meeting with additional results and proceed with preliminary modeling recommendation**
  - The NYISO aims to develop a tiered gas constraint model (as discussed in prior slides), with different winter load levels as triggering conditions
  - The NYISO also aims to develop processes to mitigate and balance the volatility and accuracy of the IRM study
- **The NYISO anticipates developing a final recommendation on gas constraint model by the end of 2023, and therefore the final report is expected to be completed early 2024**
  - The NYISO expects on-going discussion with the ICS in the development of the final modeling recommendation
  - The final report will serve as a summary of all the prior research and discussion

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Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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Questions?

Appendix

Background

- **As supported by the NYSRC and stakeholders, the NYISO is conducting research analyzing the impact of extreme winter conditions on gas availability to New York electric power generators**
- **The gas constraints whitepaper is part of the 5-year strategic plan for Resource Adequacy (“RA”) modeling improvements**
  - The scope of this whitepaper was discussed and accepted at the 2/1/2023 ICS meeting and an update on the modeling and research was presented at the 5/30/2023 ICS meeting

    Gas Constraints Whitepaper: Scope (2/1/2023 ICS):
    https://www.nysrc.org/PDF/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20273/Gas%20Constraints%20Whitepaper_Scope_2023.02.01_revised[13443].pdf
    Gas Constraints Whitepaper Update (5/30/2023 ICS):
    https://www.nysrc.org/wp-content/uploads/2023/07/11_ICS_GasConstraintsWhitepaperUpdate_2023.05.30_v415826.pdf
  - A Winter Constraints sensitivity relating to this modeling effort was presented at the 8/29/2023 ICS meeting

    Winter Constraints Sensitivities (8/29/2023 ICS):
    https://www.nysrc.org/wp-content/uploads/2023/08/WinterConstraintsSensitivities_2023.08.2921424.pdf
  - This effort is also being coordinated with the Capacity Market Design’s Modeling Improvements for Capacity Accreditation Project (Previous discussions on next slide)
- **The objective of the whitepaper is to develop enhancements to appropriately reflect the impact of gas constraints during the winter period in the IRM study, via answering the following questions:**
  - What are the characteristics of winter gas constraints on the availability of electric power generators?
  - What are the reasonable levels of such gas constraints to be reflected in the IRM study while avoiding potential double counting with an electric power generator’s forced outage rate?
  - What is the recommended modeling approach to represent these characteristics in the RA model?

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Timeline

Milestone	Date
Present Scope to NYSRC	2/1/2023
Finalize Scope	2/15/2023
Monthly ICS Updates	Ongoing
Identify Factors for Reasonable Gas Constraint Modeling Characteristics	Q1 2023
Additional Analysis and Gas Constraint Characterization	Q2 2023
Research Completed	Q2 2023
Present Findings of Research at ICS	End of Q2 2023
MARS Modeling Development and Testing	Q3 – Q4 2023
Present Findings/Modeling Enhancement Recommendations to NYSRC	December ICS Meeting
Implement NYSRC Approved Changes to IRM Model -- *sensitivity in the PBC and possible base case adoption in 2025-2026 IRM Study*	Following NYSRC Review

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Previous Discussions on Capacity Market Design's Efforts

- Modeling Improvements for Capacity Accreditation: Natural Gas Constraints
- 2/28/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/36499713/Gas%20Constraints%2002_28_2023%20ICAPWG_Final.pdf/e258d867-12f9-8453-c93b-49bc94b8e803
- 4/27/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/37254128/Natural%20Gas%20Constraints%202023_04_27_Final.pdf/0821aba8-bdcd-b1ce-96f3-2d8a740e1356
- 6/1/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/37883690/Natural%20Gas%20Constraints%2006_01_2023_ICAPWG_Final.pdf/d479ea64-a0d0-86d1-388a-f93d01ff1e10
- 6/23/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/38423065/2%20Natural%20Gas%20Constraints_06_23_2023_ICAPWG_Final.pdf/177ad95e-1fa3-5c57-a626-d06182b55c9b
- 8/9/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/39257338/Natural%20Gas%20Constraints_08_09_2023%20ICAPWGv4%20(002).pdf/de6053e0-030d-5520-ed59-18f2225f0f92
- 9/20/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/40085480/Natural%20Gas%20Constraints_9_20_2023_v4.pdf/8c76a250-d1e0-d30a-2c24-115f10268c65
- 10/10/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/40481418/2%20Natural%20Gas%20Constraints_10_10_v3.pdf/7f39851d-f477-6a12-d7d2-52f52af87fcb

Modeling Concepts

- **Four modeling concepts are currently being considered:**
  - Modeling Concept 1: Gas Constraint Triggered by Load Condition via Dummy Profile
  - Modeling Concept 2: Gas Constraint Triggered by Load Condition via Specific Dates
  - Modeling Concept 3: Gas Constraint Modeled with Dummy Bubbles and Topology Limits
  - Modeling Concept 4: Gas Constraint Modeled with Negative EOP Step
- **The NYISO has worked with GE to conduct screening of these modeling concepts to select an option for further modeling development. The screening considerations are:**
  - Feasibility to implement the modeling concept in GE MARS
  - Ability to implement without affecting base case results
  - Ability to differentiate gas constraints by bin level
  - Ability to customize the constraint to the daily/hourly level
  - Ability to dynamically account for generator outages

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Modeling Concept Screening

Screening Considerations	Modeling Concepts			
	Gas Constraint Triggered by Load Condition via Dummy Profile	Gas Constraint Triggered by Load Condition via Specific Dates	Gas Constraint Modeled with Dummy Bubbles and Topology Limits	Gas Constraint Modeled with Negative EOP Step
Feasiblity in the GE MARS Model	Medium High	Medium High	Medium	High
Ability to implement without affecting base case results	High	High	Low	High
Ability to differentiate gas constraint by bin level	High	High	High	Low
Ability to customize constraint to daily/hourly level	High	Medium	High	Medium Low
Ability to dynamically account for generator outages	Medium Low	Medium Low	High	Medium Low
Overall Comparison of Pros/Cons	Straightforward implementation Highly customizable No undesired impacts	Straightforward implementation Customizable to an extent No undesired impacts	Complex implementation Highly customizable May have undesired impacts	Simplest implementation Limited customization No undesired impacts

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Modeling Concept 1

- **Gas Constraint Triggered by Load Condition via Dummy Profile**
  - A dummy intermittent resource is added to the GE MARS model with hourly production profiles
    - Unit will be added to a dummy zone as to not impact base case results
  - The hourly production profiles are used to derate gas constrained generators to remove the desired amount of ICAP from the simulation

Pros	Cons
• No GE development needed • Straightforward modeling implementation • No impact to base case results • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily or hourly level	• Unable to dynamically account for generator outages (potential to undercount desired impact)

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Modeling Concept 2

- **Gas Constraint Triggered by Load Condition via Specific Dates**
  - A date range condition predetermined based on the load shapes is added to the GE MARS model
  - During the date range implemented, the gas constrained generators are derated to remove the desired amount of ICAP from the simulation

Pros	Cons
• No GE development needed • Straightforward modeling implementation • No impact to base case results • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily level	• Unable to customize constraint down to the hourly level • Unable to dynamically account for generator outages (potential to undercount desired impact)

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Modeling Concept 3

- **Gas Constraint Modeled with Dummy Bubbles and Topology Limits**
  - Dummy bubbles connected to load zones are created in the GE MARS model (e.g., Zone G is connected to Zone G_Dummy)
  - All gas constrained generators are moved in the model from the load zone to the dummy bubble
  - Interface limits are implemented during predetermined periods to limit the amount of capacity that can be provided to the load zone from the dummy bubble

Pros	Cons
• No GE development needed • Able to have different gas constraint magnitude at different load bins • Able to customize constraint down to the daily or hourly level • Able to dynamically account for generator outages	• Complex modeling implementation • May impact base case results (undesired impacts have been identified in testing when moving large numbers of generators to dummy bubbles)

Modeling Concept 4

- **Gas Constraint Modeled with Negative EOP Step**
  - A negative EOP step is added to the GE MARS model that effectively removes generation from the system, similar to how Operating Reserves are modeled at EOP step 1

Pros	Cons
• No GE development needed • Simplest modeling implementation • No impact to base case results	• Unable to have different gas constraint magnitude at different load bins • Unable to customize down to the daily or hourly level • Unable to dynamically account for generator outages (potential to overcount desired impact)