Gas Constraints Whitepaper Update

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NYISO

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Agenda

- Background
- Gas Constraint Modeling & Magnitude
- Modeling Alignment with Markets
- Preliminary Test Results
- Next Steps
- Appendix

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Background

- As supported by the NYSRC and stakeholders, the NYISO is conducting research analyzing the impact of winter conditions on gas availability to New York electric power generators with an initial focus on impacts in Load Zones F - K
  - The objective of the whitepaper is to reflect the risk of gas unavailability under cold weather conditions during the winter months in the IRM model
- The NYISO has received stakeholder feedback from prior gas constraint modeling discussions and has more information on the determination of gas constraint magnitude levels and the modeling methodologies
- The NYISO Capacity Market Design team is concurrently working on a capacity accreditation effort to classify generators based on fuel availability decisions (i.e., firm/partial firm vs non-firm optionality)
  - The Resource Adequacy (RA) team and Capacity Market Design team have been in close collaboration in their efforts

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Magnitude & Modeling Questions

Gas Constraint Modeling: Initial Characteristics and Concept

- **The NYISO previously reviewed the initial gas constraint inputs (more details in Appendix)**
  - The gas constraints will initially be applied to gas generators in Load Zones F – K during the winter months based on load level
- **The NYISO also screened and reviewed four modeling concepts with GE and the NYSRC (more details in Appendix)**
- **The preferred modeling concept at this point is to derate the winter capacity of affected generators modeled in the IRM study based on load conditions**
  - There are varying magnitudes of derates that would be applied based on the daily peak load level in the GE MARS simulation (more detail on the magnitudes in later slides)
  - Two methods of derates are being explored (“existing unit derate” and “negative unit”)
- **Test results with preliminary gas constraint magnitude levels were previously presented utilizing both the existing unit derate and negative unit methodologies**
  - The existing unit derate methodology showed no impact to the IRM and LOLE, while the negative unit methodology showed an increase of 0.02% to the IRM

11/1/2023 ICS: https://www.nysrc.org/wp-content/uploads/2023/10/GAS-Constraint-Whitepaper-Update-ICS-110122936.pdf

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Gas Constraint Magnitude Approach

- **NYISO reviewed internal operational data and EPA emissions data during the past 6 winters (2017-2022). Both showed a similar relationship between the amount of gas production from Load Zones F - K generators and NYCA winter load**
  - The operational data uses internal NYISO information to estimate the amount of hourly production by fuel type
  - With assistance from the Market Monitoring Unit (MMU), assumptions for carbon dioxide emission rate per fuel type were used to approximate hourly production by fuel type with the EPA emissions data
  - However, both sets of data do not separate economic fuel decisions from availability driven decisions
- **This is a similar approach to the methodology used by the MMU in its 2022 gas availability assessment**
  - MMU 2022 presentation: https://www.nyiso.com/documents/20142/33916814/MMU%20Gas%20Availability%20Presentation__20221020.pdf
  - The impact of liquefied natural gas (LNG) was accounted for in the MMU assessment
- **The historical production analysis was used to estimate the potential impact of gas constraints and to determine initial gas constraint magnitude levels based on load level**

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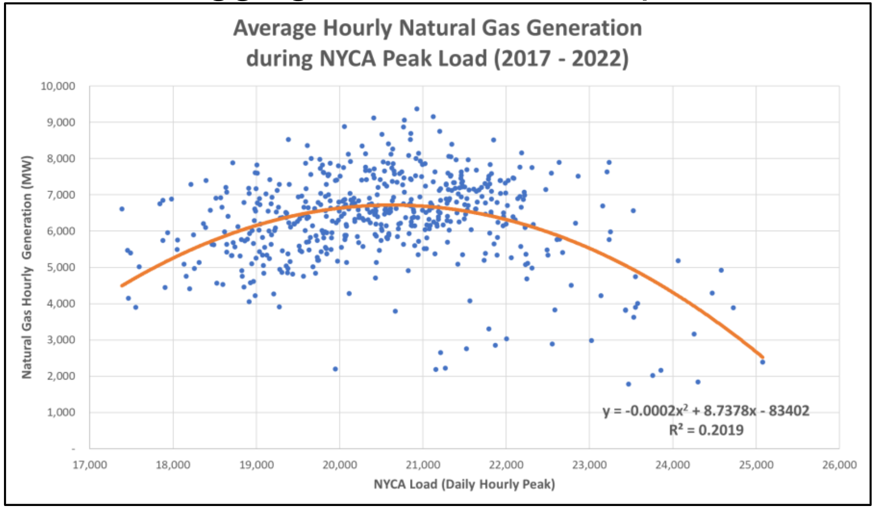
Gas Constraint Magnitudes

- Figure below shows hourly gas production for gas-only and dual fuel units in Load Zones F – K during peak winter load hours
  - Based on the 2023 Gold Book, the total ICAP for gas and dual fuel in Load Zones F – K is approximately 21,500 MW
  - Associated hourly production by oil or other alternative fuel is not included in the data
- Load Zones F – K natural gas generation decreases significantly when NYCA load rises above 22,000 MW, despite increasing gas generation as loads rise up to 21,000 MW



- The peak of the regression trendline is ~6,750 MW
  - These MW levels should be considered as UCAP since they are based on actual production
- Inputs to the gas constraint model would be based on the gap between available gas generation and its peak, along the trendline
  - For NYCA load levels in excess of 26,000 MW, the available gas generation is expected to be at or near 0 MW based on the trendline. Therefore, the input to gas constraint model at > 26,000 MW NYCA Load = (6,750 – 0) MW

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Gas Constraint Magnitudes (cont.)

- **The inputs to the six-tiered gas constraint model are shown in the table below, using the trendline presented on the previous slide**
  - As the constraint levels are calculated using the daily peak, the constraint will be applied to the entire day when the daily peak conditions are satisfied

Tier	Corresponding NYCA Daily Peak Conditions (MW)	Gas Constraint Magnitude (MW)
1	>26,000	6,750 (6,750 – 0)
2	25,000 - 26,000	6,000 (6,750 – 750)
3	24,000 - 25,000	4,000 (6,750 – 2,750)
4	23,000 - 24,000	2,250 (6,750 – 4,500)
5	22,000 - 23,000	1,250 (6,750 – 5,500)
6	<22,000	0 (6,750 – 6,750)

- **These load conditions and gas constraint magnitudes are based on historical winter data and would be reviewed in future IRM cycles as system conditions change and winter load levels increase**

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Consideration for Model Implementation

- **Two methodologies for implementing the gas constraints model are being considered**
  - The negative unit methodology would implement the derate on a UCAP basis, aligning with the analysis in developing the gas constraint magnitude levels
  - The derating existing units methodology would implement the derate on an ICAP basis, and therefore the interaction with (and potential for overlap with) unit forced outages will need to be considered
- **In the near term, the two options are not expected to materially impact the study results**
  - Test cases on this year's IRM database with both options, with the same MW levels, have been presented at the 11/01/2023 ICS meeting
- **ICS requested additional test cases with tighter winter conditions to demonstrate the impacts between the two implementation options**
  - Supplemental testing results are presented in the later slides

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Aligning Modeling Inputs with CARC Assignments

Capacity Accreditation Resource Class (CARC) Classifications

- The Capacity Market Design team has developed the following proposal:

  11/8/2023 ICAPWG: https://www.nyiso.com/documents/20142/41049783/Natural%20Gas%20Constraints_11_8_w_Tariff_v5.pdf

Fuel Arrangements	Class (CARCs)
Dual Fuel/Oil Only: Demonstrated Inventory + Tested Dual Fuel: Not Demonstrated and/or Tested + Firm Transportation	Firm
Gas Only: Firm Transportation (Includes LDC Connected units with Firm Transportation on Pipeline and LDC)	
Additive Contracts/Arrangements: Multiple Firm Transportation/Alternate Fuel Contracts satisfying applicable requirement/contracts on primary and secondary that do not meet individual requirements but additively carry the capacity value across Dec., Jan., Feb.	
Any of the above firm arrangements to the MW level satisfied	Partial Firm Election
Gas Only: Fuel Constrained LDC Connected/Fully Interruptible, Interstate Direct Connect w/o Firm Transportation	Non-Firm
Dual Fuel/Oil Only: No Demonstrated Inventory/not tested	

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CARC Assignments and Modeling Inputs

- Generator CARC assignments will be based on fuel availability decisions (i.e., firm, partial firm, or non-firm) elected in the August prior to the applicable Capability Year for which the election applies
- While there is a desire to reflect fuel availability decisions, as reflected in the CARC assignments, in the IRM study model, there are also concerns about potential volatility of IRM study results driven by these possible changes year-over-year
- Two options of accounting for annual CARC assignments when developing the gas constraint model inputs were discussed at the 11/01/2023 ICS meeting
  - Option 1: Static Gas Constraint Risk
  - Option 2: Conditional Gas Constraint Risk
  - More details on both options are provided in the following slides

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Option 1:
Static Gas Constraint Risk

- Under this option, the amount of gas constraint risk (i.e., derate applied by load level) based on historical analysis of production data in the model remains unchanged by the annual CARC assignments
- The applicable derate level is applied first to units in Load Zones F - K electing non-firm capacity
  - If the applicable derate exceeds the MW quantity of non-firm capacity, the remainder would be applied to the units in Load Zones F – K with demonstrated firm capacity

Tier	Corresponding NYCA Daily Peak Conditions (MW)	Gas Constraint Magnitude (MW)
1	>26,000	6,750
2	25,000 - 26,000	6,000
3	24,000 - 25,000	4,000
4	23,000 - 24,000	2,250
5	22,000 - 23,000	1,250
6	<22,000	0

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Option 2:
Conditional Gas Constraint Risk

- **Under this option, the amount of gas constraint risk (<u>i.e.</u>, derate applied by load level) in the model can vary based on the MW quantity of non-firm CARC assignments in Load Zones F - K, but would be capped at the maximum applicable derate amount determined by historical analysis of production data**
  - The methodology to determine the amount of gas constraint risk from the total capacity from units electing non-firm capacity will need to be developed
- **The applicable derate level is applied only to units in Load Zones F - K assigned to a non-firm CARC**
  - The gas constraint magnitudes will be limited to not exceed the amount of non-firm capacity
  - The methodology to determine the applicable MW magnitude derates to apply if the total non-firm capacity is less than the derate level determined based on historical analysis of production data would need to be developed

Tier	Corresponding NYCA Daily Peak Conditions (MW)	Gas Constraint Magnitude (MW)
1	>26,000	Min(6,750, Non-Firm Gas Constraint Risk)
2	25,000 - 26,000	Min(6,000, Non-Firm Gas Constraint Risk)
3	24,000 - 25,000	Min(4,000, Non-Firm Gas Constraint Risk)
4	23,000 - 24,000	Min(2,250, Non-Firm Gas Constraint Risk)
5	22,000 - 23,000	Min(1,250, Non-Firm Gas Constraint Risk)
6	<22,000	0

Options 1 & 2 Considerations

- **Both options for gas constraint inputs are feasible and implementable in the IRM study. But there are different trade-offs between the two options:**
  - Option 1 provides maximum stability for IRM results but risk in potential for sub-optimal alignment between the static inputs in the model and anticipated levels of non-firm gas utilization
    - Question to consider: Should the model reflect the same gas constraint risk (i.e., modeled derate by load level) based on historical data regardless of fuel availability decisions (i.e., firm, partial firm, or non-firm) or should the magnitude of the modeled derate also account for the level of firm capacity elections?
  - Option 2 provides stronger alignment between CARC assignments and the model but risk in potential for year-over-year volatility in IRM study results driven by changes in fuel availability decisions
    - Question to consider: If all units elected firm capacity, should the model reflect no gas constraint risk on the NYCA system?
- **Should other options be considered?**
  - For example, risk related to firm oil storage can be informed by fuel availability decisions and could be used in assessing/determining the MW magnitude derates levels to be modeled

Consideration for CAFs

- Consideration for Capacity Accreditation Factors (CAF) was also raised during the 11/01/2023 ICS meeting
- The CAF aims to reflect the marginal reliability value of each resource class. When proper risks are captured in the base IRM model, it will help ensure the proper marginal reliability value is captured with the CAF calculations
  - At this point, the methodology for modeling the non-firm proxy to calculate a CAF has not been finalized
- It is important to capture the real and aggregated gas constraint risks in the IRM model so that the IRM is properly established, and it forms the proper starting point for the subsequent CAF calculations
  - Currently the aggregated risk for gas constraint is based on the historical analysis of production data

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Preliminary Test Results

Initial Preliminary Test Results: 2024 IRM FBC

- **Testing of the existing unit derate and negative unit methodologies was conducted on the 2024 IRM Final Base Case (FBC) to determine the potential impact of both methodologies using the modeling and MW derate quantities described on Slide 8**
  - Neither method impacted the IRM or LCRs (No deltas)
    - The existing unit derate method had no impact on LOLE, while the negative unit approach moved the LOLE a small amount, but not enough to impact the results

Case	IRM (Delta)	J LCR (Delta)	K LCR (Delta)	G – J (Delta)
2024 IRM FBC (Base Case)	23.1%	72.7%	103.2%	84.6%
Existing Unit Derate	23.1% (-)	72.7% (-)	103.2% (-)	84.6% (-)
Negative Unit	23.1% (-)	72.7% (-)	103.2% (-)	84.6% (-)

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Initial Preliminary Test Results: 2024 IRM FBC + Increased Winter Risk

- **To simulate tighter winter conditions, the NYISO increased the winter risk by removing perfect capacity during winter in the model by about 3,300 MW and then conducted the same analysis described on the prior slide. The capacity reduction had no impact to the base case IRM or LOLE**
  - The difference in the impact is largely driven by the gas constraint impact (i.e., applicable derate by load level) being implemented as UCAP reduction in the negative unit method while existing unit derate method implements the gas constraint impact as ICAP reduction

Case	IRM (Delta)	J LCR (Delta)	K LCR (Delta)	G – J (Delta)
2024 IRM FBC (Base Case) + increased winter risks	23.1%	72.7%	103.2%	84.6%
Existing Unit Derate	23.6% (+0.5)	73.1% (+0.4)	103.7% (+0.5)	85.0% (+0.4)
Negative Unit	24.1% (+1.0)	73.5% (+0.8)	104.2% (+1.0)	85.4% (+0.8)

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Next Steps

Next Steps

- **The NYISO will continue to refine the potential modeling constructs and recommendations based on inputs received from the ICS, and plans to return to the next ICS meeting with additional test results to support proceeding with modeling recommendations**
  - 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 the gas constraint model and finalizing the whitepaper report in early 2024**
  - The NYISO expects on-going discussion with the ICS in the development of a final modeling recommendation
  - The final report will serve as a summary of all the prior research and discussion

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
- 4/27/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/37254128/Natural%20Gas%20Constraints%202023_04_27_Final.pdf
- 6/1/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/37883690/Natural%20Gas%20Constraints%2006_01_2023_ICAPWG_Final.pdf
- 6/23/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/38423065/2%20Natural%20Gas%20Constraints_06_23_2023_ICAPWG_Final.pdf
- 8/9/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/39257338/Natural%20Gas%20Constraints_08_09_2023%20ICAPWGv4%20(002).pdf
- 9/20/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/40085480/Natural%20Gas%20Constraints_9_20_2023_v4.pdf
- 10/10/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/40481418/2%20Natural%20Gas%20Constraints_10_10_v3.pdf
- 11/8/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/41049783/Natural%20Gas%20Constraints_11_8_w_Tariff_v5.pdf
- 11/17/2023 ICAPWG:
  https://www.nyiso.com/documents/20142/41273741/Natural%20Gas%20Constraints_11_17_ICAPWG_v3.pdf

Gas Constraint Modeling: Initial Characteristics

- **Gas constraints are to be applied to certain thermal units in Load Zones F – K**
  - Prior analysis by the MMU demonstrates the current significance of pipeline bottlenecks in southeast NY https://www.nyiso.com/documents/20142/33916814/MMU%20Gas%20Availability%20Presentation__20221020.pdf
  - Gas constraints will not initially be applied to units in Load Zones A – E
    - Further analysis is required to determine the prevalence of significant gas constraints in Load Zones A - E
    - Gas constraints can be applied to Load 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, as necessary, updated as new information becomes available

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

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**

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)

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)