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Independent System Operator

EOP Review Whitepaper Progress

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Background

- The Emergency Operation Procedure ("EOP") whitepaper is part of the 5-year strategic plan for Resource Adequacy ("RA") modeling improvement
- The purpose of the EOP whitepaper is to research how EOPs, especially Emergency Assistance ("EA"), are accounted for in the IRM base case model, and recommend changes that are appropriate
- The scope of the whitepaper includes 4 major questions:
  - How are EOPs, especially EA, accounted for in GE MARS model?
  - How do neighboring systems support NYCA during emergency conditions?
  - How much can NY depend on neighboring jurisdictions during emergency situations?
  - Is it appropriate to consider advancing some support from neighboring systems ahead of the EOPs in the IRM study?

Scope of the whitepaper is presented at 2/1 ICS meeting:
https://www.nysrc.org/PDF/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20273/EOP_Whitepaper_Scope_revised[13442].pdf

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Timeline of the Whitepaper

Milestone	Date
Present Scope to NYSRC	2/1/2023
Finalize Scope	2/15/2023 (Following NYSRC approval)
Monthly NYSRC Updates	Ongoing
Review of EA Model and EA in Grid Operations Complete	April 2023
Determine Potential Changes to EA Model and Modeling Test	May-July 2023
Present Research and Recommendations to NYSRC	August ICS Meeting
Potential New Modeling Adoption and Sensitivity Cases	Pending ICS Review (2024/25 FBC)
Final Modeling Change (if applicable) *-- adoption in the FBC of 2024/25 IRM, or* *-- sensitivity in the PBC of 2025/26 IRM*	Following NYSRC Review
Initiate Scoping for Tie and Seasonal EA Modeling Whitepaper (2024 initiative) *--consider mid-year 2024 completion*	Q4 2023

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Reviewing the Emergency Assistance

- **The current IRM assumptions for EA from external areas are based on the knowledge and understanding of the Northeast regional system about 5 years ago**
  - The regional system had relatively high reserve margins and small supply mix changes
- **The NYISO considers the following three aspects when reviewing the EA assumptions in the IRM study:**
  - Review the current assumptions on external area support and how they affect today's IRM study
  - Review the recent experience of interactions with the neighbors for the perspective of today's Northeast regional system
  - Review the outlook of external areas and their RA assumptions for supports from the region
- **These reviews aim to answer the question of *whether our understanding of the Northeast regional system should change and should we consider changing our modeling assumptions***

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IRM Study Assumptions and Effect

Current IRM Assumptions on EA

- **Currently, EA from the external areas is restricted by the combination of the following limits**
  - Inter ties are open until EOP step 8 (current EA provider priority order: IESO→HQ→ISONE→PJM)
  - Transfer capabilities of individual interties based on NPCC database
  - Global EA limit of 3500 MW
  - Policy 5 requirements on external area modeling
    - Align the top 3 peak load days of the external areas to the ones of NYCA
    - Generation and load balancing in the external areas is no better than the areas' RA criteria (i.e. LOLE) and the areas' referenced margin
- **Therefore, during MARS simulation, the amount of EA from external areas are available only when *all* of the following conditions are met:**
  - Deficiencies in NYCA are not addressed by the first 7 steps of the EOP
  - When the interties are closed, the external jurisdictions have surplus generation
  - Flows of EA from a given jurisdiction are limited by the intertie capabilities
  - Total flows of EA from all the external jurisdictions do not exceed 3500 MW

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Emergency Assistance in Simulation

- **During GE MARS simulation, EA flows from the external areas are made available at and after EOP step 8, to address the deficiencies in the NYCA**
  - These EA sometimes would successfully address the NYCA deficiencies and avoid triggering a Loss of Load event
  - The EA continues to exist during Loss of Load event when deficiencies in NYCA cannot be addressed
- **The NYISO reviewed the EA flow from 2023-2024 IRM Final Base Case, which represents the system at-criteria**
  - The analysis focuses on EA during the Loss of Load event. The EA flow before a loss of load event is also reviewed.
- **The analysis of EA flows also distinguishes the system conditions by different Load Forecast Uncertainty ("LFU") bins as the frequency of Loss of Load event and EA flows is highly correlated with the assigned bin levels during the simulation**
  - Bin 1 represents the most severe weather conditions (1 in 160-year) and has the lowest probability of occurrence (0.62%)
  - Bin 2 represents 1 in 15-year hot peak day
  - Bin 3 represents warmer than average peak weather conditions (90/10 forecast lies within Bin 3)
  - Bin 4 represents 50/50 forecast
  - Bin 5-7 represent lower than average peak weather conditions

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EA before Loss of Load

- **During IRM simulation, EA is utilized to avoid over 1/3 of the Loss of Load events, at a lower flow level compared to the situation during the Loss of Load events**
  - The expected hours of assistance per replication is generally less than the hours during Loss of Load event (see Appendix A1)
    - There are more hours of assistance before Loss of Load event in Bin 2 than during Loss of Load event
    - During Bin 3 and below, the expected hours of assistance is less than 1 hour
  - During Bin 1-3, NYCA needs the full EA of 3500 MW (see Appendix A1)
    - NYCA needs some EA in Bin 1-5
  - EA flows before Loss of Load events are more evenly spread across the flow range but the flows are more concentrated between 0 MW to 2100 MW (see Appendix A2)
    - Generally, the frequency of EA prior to Loss of Load is less than the EA hours during Loss of Load
    - In Bin 2, the frequency of EA prior to Loss of Load event is greater than during Loss of Load event
  - On average, NYCA depends on IESO and ISONE the most (see Appendix A3)
    - Dependency on PJM is higher prior to Loss of Load event than during Loss of Load event

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EA during Loss of Load

- **During IRM simulation, NYCA needs external assistance during Bin 1-5**
  - During Bin 1-3, NYCA needs the full EA of 3500 MW
  - During Bin 4 and 5, NYCA needs some EA, but the flow does not reach 3500 MW
  - No Loss of Load event is triggered during Bin 6 and 7
  - The expected hours of assistance per replication during Bin 1 is 21.98 hours
  - The expected hours of assistance per replication is less than 1 hour during Bin 3 and below

LFU Bins	Max EA (MW)	Expected Hours with EA (hours)
Bin 1 [1 in 160 years]	3500	21.98
Bin 2 [1 in 15 years]	3500	2.68
Bin 3 [90/10 forecast]	3500	0.17
Bin 4 [50/50 forecast]	995	0.02
Bin 5	404	<0.01
Bin 6	0	0
Bin 7	0	0

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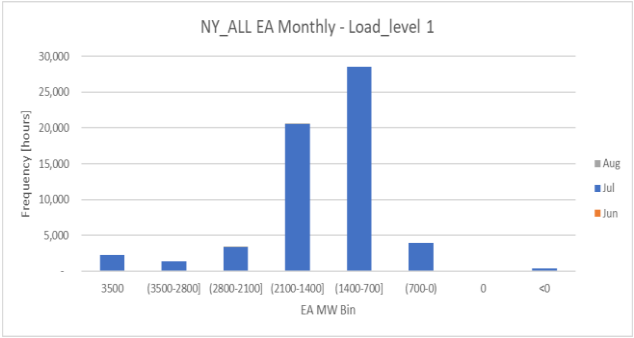
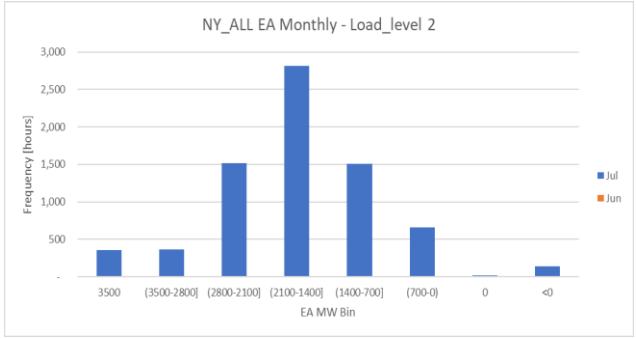
Duration of EA during Loss of Load

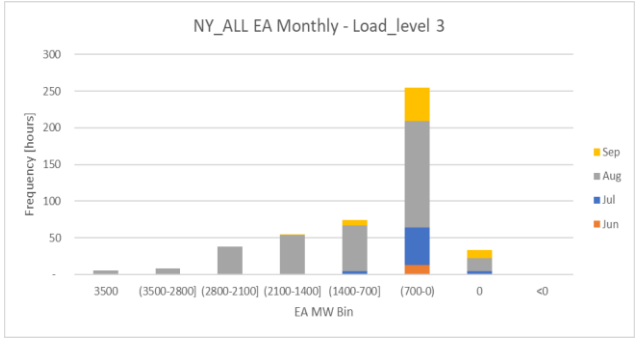
- **When NYCA needs external assistance, the maximum EA of 3500 MW is reached during Bin 1-3, but do not always require the maximum level of assistance**
  - During Bin 1 and 2, most EA flows are between 700 MW to 2100 MW
  - During Bin 3 and 4, most EA flows are between 0 MW to 700 MW
  - During Bin 1, 2 and 3, NYCA requires the maximum EA of 3500 MW 4%, 5%, and 1% of the time respectively

Percent distribution of EA flow MW when NYCA needs assistance

EA Flow	Bin1	Bin2	Bin3	Bin 4
3500	4%	5%	1%	0%
(3500-2100]	8%	26%	10%	0%
(2100-700]	81%	59%	28%	4%
(700-0]	7%	9%	62%	96%
<0	1%	2%	0%	0%
EA Hours	21.98	2.68	0.17	0.02







Based on the approved 2023 IRM Final Base Case

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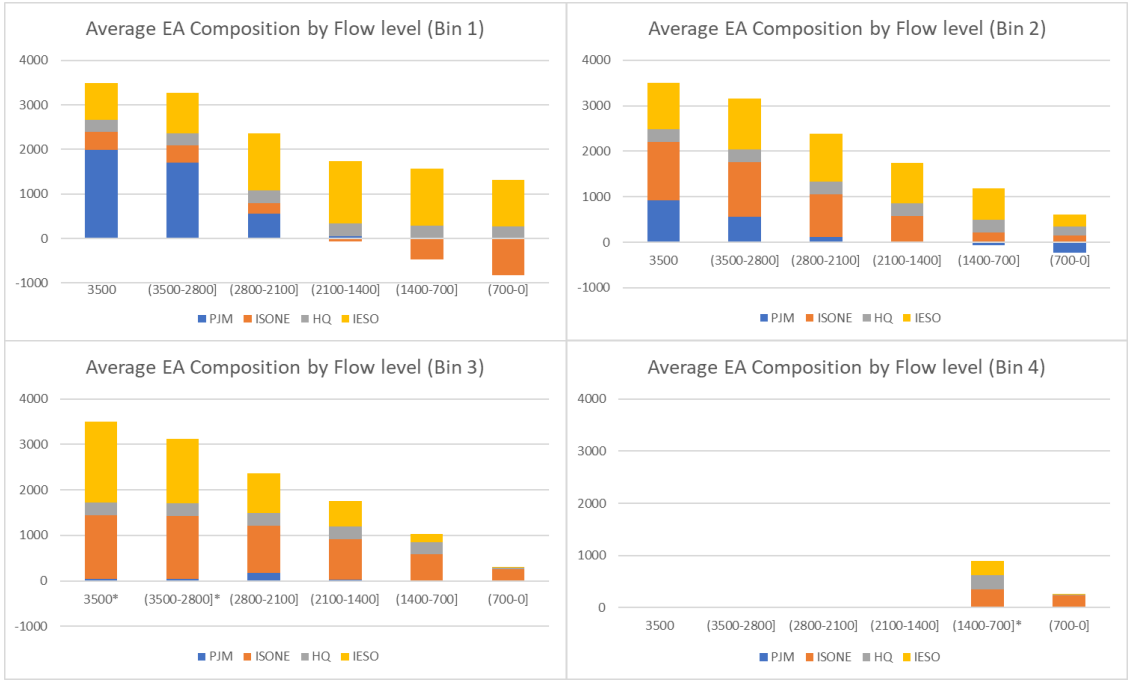
Composition of EA during Loss of Load

- **On average, NYCA relies on IESO and ISONE the most**
  - The EA priority order as input in the model drives down the significant reliance on PJM, especially for lower bins (see Appendix B for sensitivity for changing priority orders)
  - The priority order helps distributing the support among multiple jurisdictions, with consistent EA from IESO and higher support from ISONE at lower flow level
  - The support from HQ is consistent independent of the priority order, LFU bin and the flow level
  - In top bins at the higher EA flow level, support from the PJM bridges the gap when IESO and ISONE both are likely in the same extreme conditions



*Less than 10 data points

Based on the approved 2023 IRM Final Base Case

Summary of EA during Loss of Load Event in the 2023-2024 IRM FBC

- **In the at-criteria IRM database, NYCA typically needs external assistance during Bin 1-5**
  - Upper LFU bins (i.e. more extreme weather conditions) have more EA flow, in both duration and magnitude, compared to lower LFU bins (i.e. milder weather conditions)
    - Bin 4 (50/50 forecast) requires maximum EA about 1000 MW
    - Maximum EA of 3500 MW is reached for Bin 1-3, but only for short duration

- **In the at-criteria IRM database, NYCA relies mostly on IESO and ISONE on average**
  - Support from PJM increases in upper bins at the higher flow level
  - NYCA relies more on ISONE during Bin 2 and 3, compared to Bin 1 and 4
  - HQ consistently provides at close to the maximum interface limit
  - The composition of EA is sensitive to the priority order input, but the severity of EA is unaffected

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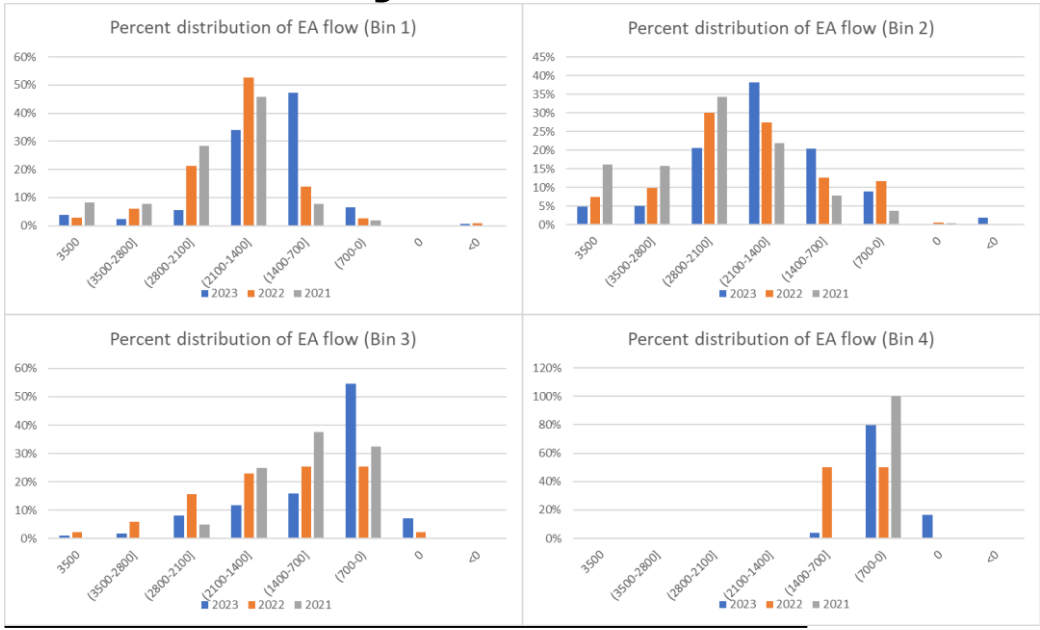
Trend of EA in the IRM Study

- **The EA flow distribution is trending downwards in recent years**
  - EA flow distribution for 2023 IRM database is more concentrated towards lower flow range compared to the 2021 and 2022 IRM database
- **There is no significant trend or difference in the maximum EA flow and the expected hours of EA between cases**
  - 2023 IRM database has Loss of Load event in Bin 5
  - In 2021 IRM database, the EA flow does not reach 3500 MW during Bin 3
- **The flow composition are similar between the cases and there is no significant trend (see Appendix C1 & C2)**



	Max EA (MW)		Expected Hours with EA (hours)	
LFU Bins	2022 FBC	2021 FBC	2022 FBC	2021 FBC
Bin 1	3500	3500	20.99	21.35
Bin 2	3500	3500	3.34	3.45
Bin 3	3500	2646	0.03	0.01
Bin 4	1125	590	<0.01	<0.01
Bin 5	0	0	0	0
Bin 6	0	0	0	0
Bin 7	0	0	0	0

Note: 2021 and 2022 IRM database input load shapes are different from 2023 IRM database

Experience during Real-Time Grid Operations

Real Time Operational Considerations

- **Important to note:**
  - Grid ops statistics are actual historical load
  - Grid ops has not seen Bin 1, 2, or 3 summer load over the past several years
  - Intertie flows are scheduled economically or based on operational requirements
    - Typically, economic flows are scheduled into the area that is shortest on energy or reserves
  - The operation observation is not comparable to the MARS simulation, especially with the at-criteria base case
- **Historical Observations**

NYCA Peak Load Days Coinciding with Neighbors (past 5 years)			
Neighboring ISO	IESO	PJM	ISONE
Summer	67%	50%	100%
Winter	83%	33%	100%

- **Key Messages**
  - Historical analysis shows that NYCA peaks summer load coincides with ISONE and IESO
    - PJM's summer loads do not always coincide with NYCA, so it allows NYCA to rely on PJM more during summer peak load days
  - The historical analysis is based on observation of transaction with externals during peak day operation
  - Typical intertie flows during tight operation conditions:
    - PJM is primary supplier of imports during peak days, followed by IESO and HQ
    - NYCA tends to export to ISONE during these events regardless of the season

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Outlook and RA Assumptions of Neighboring Systems

Outlook of External Areas

- The resource adequacy outlook of each external regions are important as their support to NYCA during emergency conditions depend on the regions' individual reserve margin.

External Area	Summary
IESO	• Identified as High-Risk area for not meeting RA Criteria • Reserve Margin shrinks significantly in the next 10 years • Short-term reliability relies largely on imports from other areas • When NYCA experiences harsh weather condition, IESO is likely to experience similar condition
	Winter Consideration: IESO is expected to turn into winter peaking in late 2020s
ISONE	• Identified as Elevated Risk area for being at risk of shortfall during extreme conditions • Short-term reliability relies largely on imports from other areas
	Winter Consideration: On-going concern with fuel availability during extended cold spell

External Area	Summary
HQ	• No regional risk identified in the summer due to winter peaking • Main source of emergency support during summer for Northeast region • Reached all-time summer peak in August 2021 and expect to set summer peak record in 2023
	Winter Consideration: Requires support from the Northeast region during winter season
PJM	• No immediate regional risk identified, • Low penetration of limited and variable resources • Thermal resources are under environmental regulation pressure • PJM's long-term projection suggests that PJM would have difficulty keeping up with expected demand growth by 2030 • Recent market issues

The summary is based on the NERC Long-Term Reliability Assessment and NPCC 2022 Summer Assessment

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EA assumptions in Other RA models

- Based on the NYSRC's 2015 EOP whitepaper, neighboring systems assumed lower EA or Tie Benefits in their respective RA model.
- Downward trending on such EA assumptions are also expected

External Area	EA / Tie Benefits *- 2015 Whitepaper*	Updates / Expected Trend
IESO	0 MW	Unchanged
ISONE	1,624 MW	2,100 MW for FCA 17; Currently reviewing Tie Benefits study methodology
HQ	1,100 MW (only winter)	Research for updates in progress
PJM	3,500 MW	No change; Expect to be reduced – confirmation in progress

2015 EOP whitepaper:
https://www.nysrc.org/pdf/Reports/IRM%20White%20Papers/Final%20Draft%20EOP%20White%20Paper%206_27_2015.pdf

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Conclusion and Next Steps

Conclusion

- **The reviews indicate that the current EA assumptions in the IRM study are too optimistic**
  - Substantial amount of EA is required in the IRM study, mainly from IESO and ISONE
  - During real time operations under tight conditions, PJM can provide primary support to NYCA; NYCA typically export to support ISONE
  - Tight supply conditions are expected across all the Northeast region, especially for IESO in summer and ISONE / HQ during winter
  - Other area's RA models generally have lower EA assumptions compared to the IRM
- **Supply mix changes are underway in neighboring systems, with traditional thermal fleet being replaced by intermittent and renewable resources, resulting in downward pressure on systems' resource adequacy conditions**
  - The homogeneity of the supply mixes (i.e., predominantly intermittent and renewables) can also lead to increasing risks of shared resource outages across multiple regions
- **Concerns over winter start to emerge across the Northeast region as several systems are showing tight conditions during winter seasons**
  - In addition, NYCA and ISONE, and potentially PJM, also share the common gas constraints due to limitation of the gas pipeline, especially during winter cold spell

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Review of Past Analysis

- **In NYSRC's 2017 Whitepaper on external area modeling, the main input to the analysis is the level of extra MW that can be expected from neighboring jurisdictions**
  - This was based on extra reserves during historical peak load periods between 2013 and 2015
  - The extra reserves were assumed to be the level of support available from the neighbors when called upon
  - However, the 2017 analysis did not breakdown to the area-specific level
- **It is beneficial to review the level of extra reserves since 2015. However, analysis solely based on historical data presents several challenges**
  - Based on real time operational experience, the historical data can only capture conditions that may be relevant to Bin 3-7; NYCA has not experienced Bin 1 or 2 conditions in recent history
  - Historical data may not reflect future conditions. Based on recent conditions in the neighboring systems, it is logical to assume that given higher loads, more MWs would be converted to energy

2017 External Area Whitepaper: https://www.nysrc.org/pdf/Reports/IRM%20White%20Papers/External%20Area%20Whitepaper.pdf

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Next Steps

- **NYISO to conduct an updated analysis and present findings at the 6/28 ICS**
  - NYISO plans to review the data for seasonal area-specific conditions
    - Additional analysis to reflect future conditions is being considered
  - NYISO to review whether it is appropriate in the IRM study to advance some support from neighboring system in conjunction with recommending limitations on EA flows
- **NYISO to develop modeling recommendations on limitations of EA flows in the IRM study in August**
  - The NYISO aims to develop seasonal and area-specific limitations of EA flows
  - The NYISO also aims to develop varying limitations to be implemented for different LFU bins
- **NYISO aims to develop process to periodically review and update EA flow limitations in the IRM study**

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Appendices

Appendix A1 – Expected Hours of EA Prior to Loss of Load Event

	Prior to Loss of Load Event		During Loss of Load Event	
LFU Bins	Max EA (MW)	Expected Hours with EA (hours)	Max EA (MW)	Expected Hours with EA (hours)
Bin 1	3500	13.13	3500	21.98
Bin 2	3500	6.24	3500	2.68
Bin 3	3500	0.20	3500	0.17
Bin 4	2273	0.01	995	0.02
Bin 5	404	<0.01	404	<0.01
Bin 6	0	0	0	0
Bin 7	0	0	0	0

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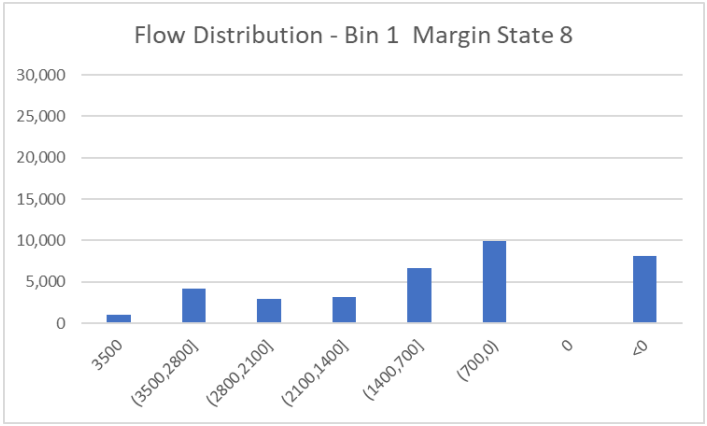
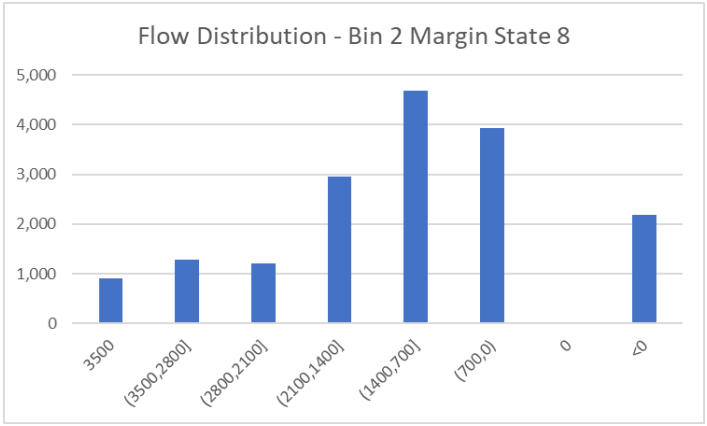
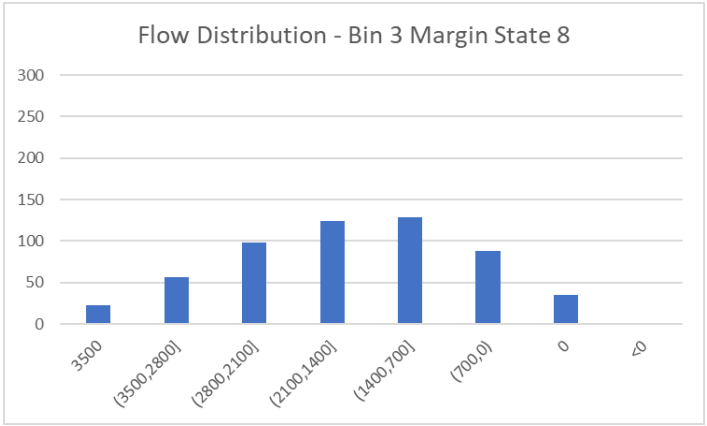
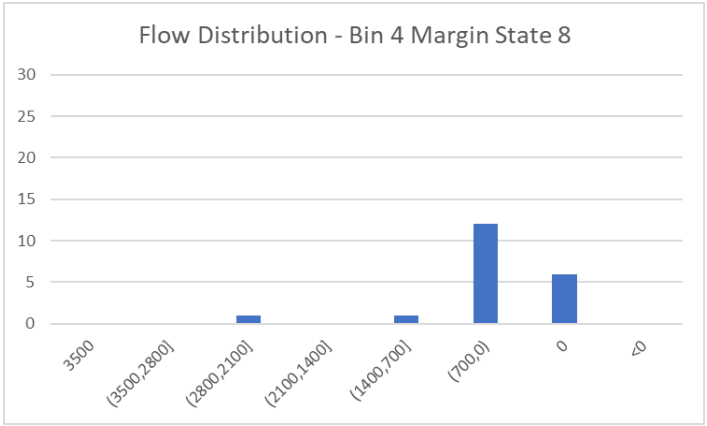
Appendix A2 – Flow Distribution Prior to Loss of Load Event









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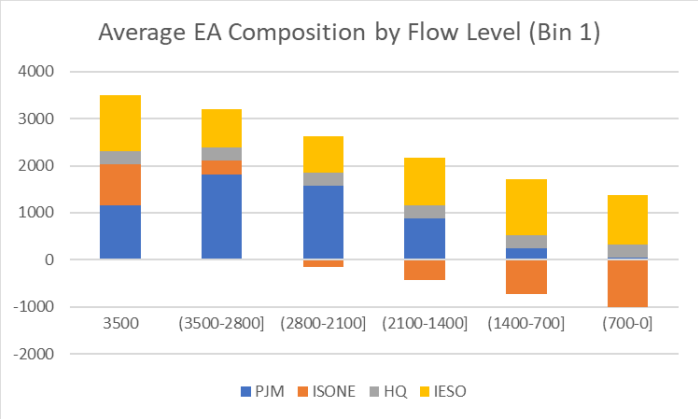
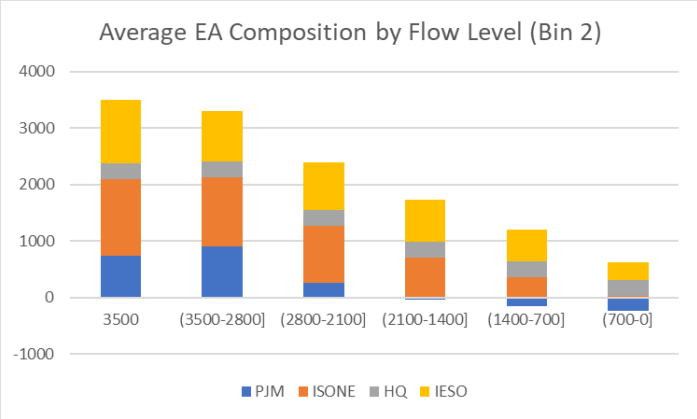
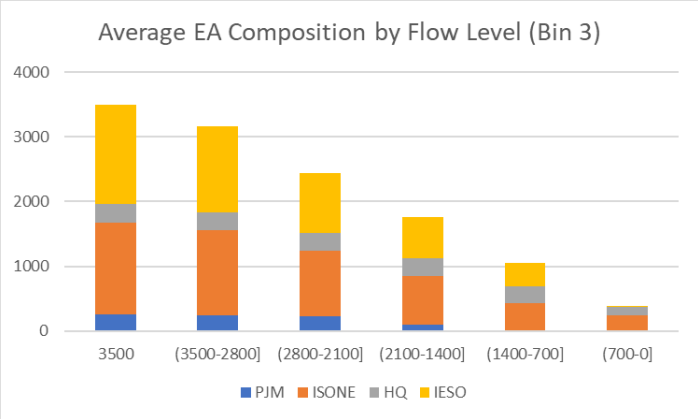
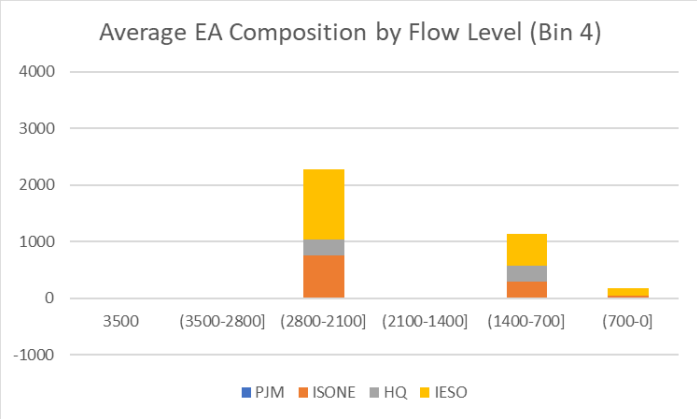
DRAFT – FOR DISCUSSION PURPOSES ONLY

Appendix A3 – Average Flow Composition Prior to Loss of Load Event









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Appendix B - Effect of Priority Order Assumption

- **To understand the effect of priority order assumption in the MARS simulation, a different assumption was tested**
  - The current assumption: IESO→HQ→ISONE→PJM
  - Tested assumption: PJM→HQ→ISONE→IESO
- **EA from PJM is sensitive to the priority order assumption, especially for lower LFU bins**
  - With the alternative assumption, PJM is the primary EA provider for NYCA during Loss of Load
  - Regardless of the priority assumption, PJM can provide the necessary support to NYCA
    - Policy 5 adjustment resulted in PJM having the highest LOLE compared to the others, but is still able to provide significant support
- **Following PJM, the system tends to rely on IESO and ISONE**
  - The new assumption deprioritizes the support NYCA receives from IESO and ISONE
- **While the priority order does not impact system LOLE or the IRM, the current assumption distributes the EA among multiple jurisdictions, rather than heavy reliance on PJM**

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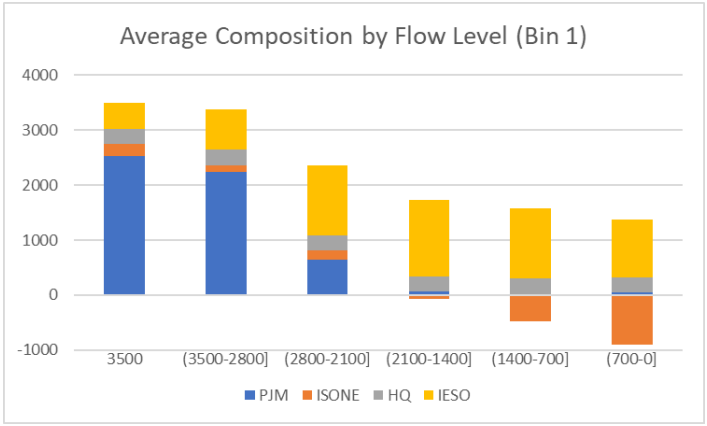
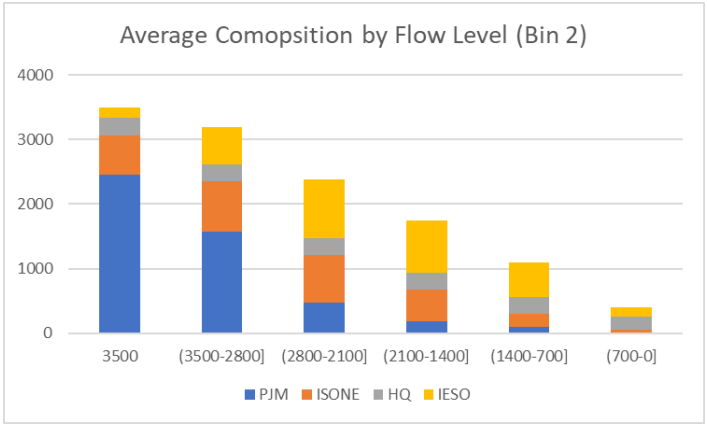
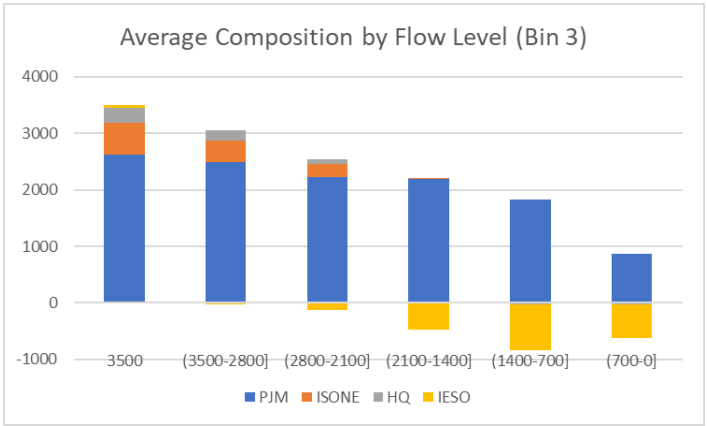
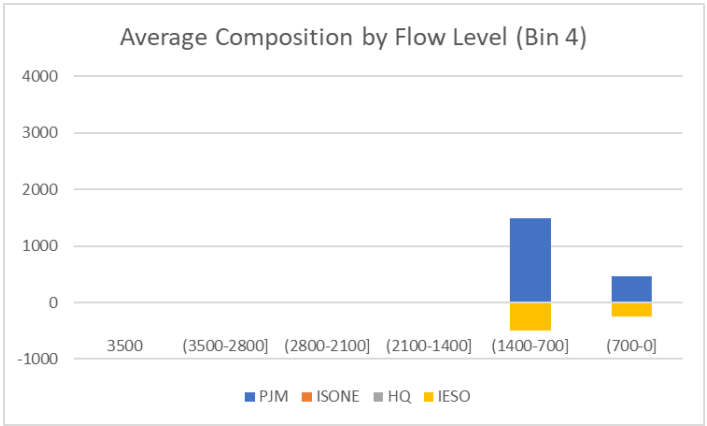
Appendix B1 – EA Flow Composition (Alternative Priority Order)









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Appendix B2 – Loss of Load Event (Alternative Priority Order)

	Alternative Priority Order (PJM→HQ→ISONE→IESO)		As-found Priority Order (IESO→HQ→ISONE→PJM)	
LFU Bins	Max EA (MW)	Expected Hours with EA (hours)	Max EA (MW)	Expected Hours with EA (hours)
Bin 1	3500	22.17	3500	21.98
Bin 2	3500	2.95	3500	2.68
Bin 3	3500	0.18	3500	0.17
Bin 4	1078	0.02	995	0.02
Bin 5	0	0	404	<0.01
Bin 6	0	0	0	0
Bin 7	0	0	0	0

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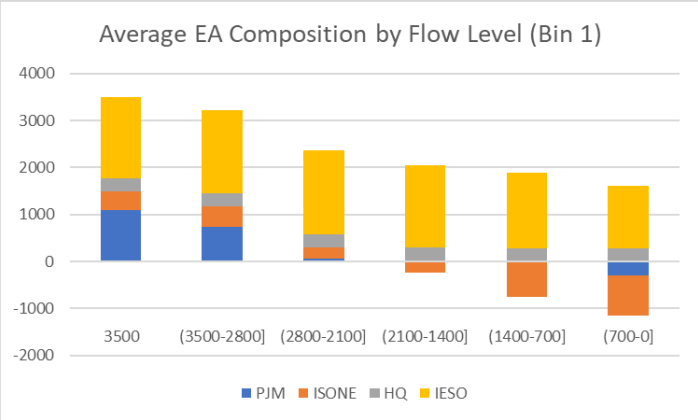
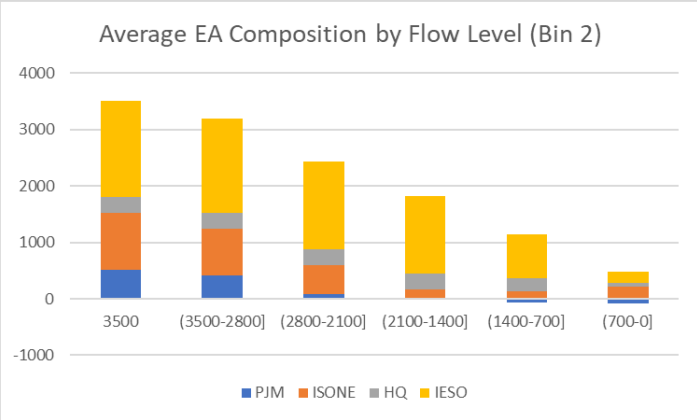
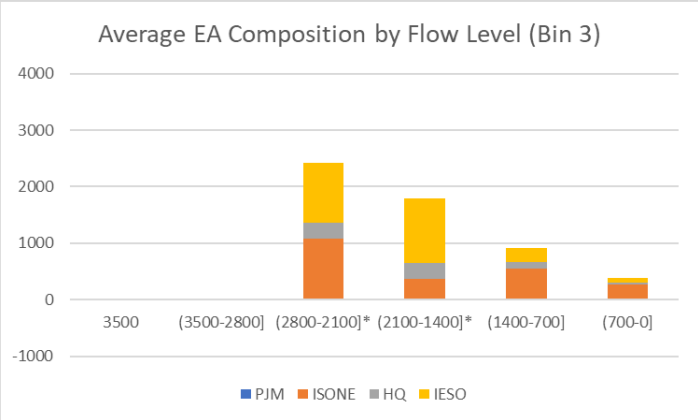
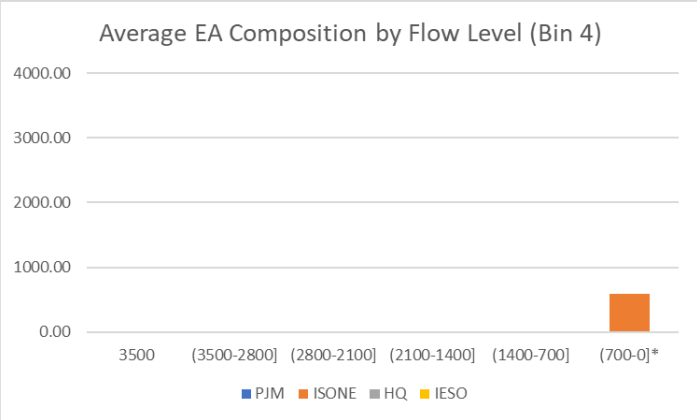
Appendix C1 – 2021 IRM Database EA Flow Composition









*Less than 10 data points

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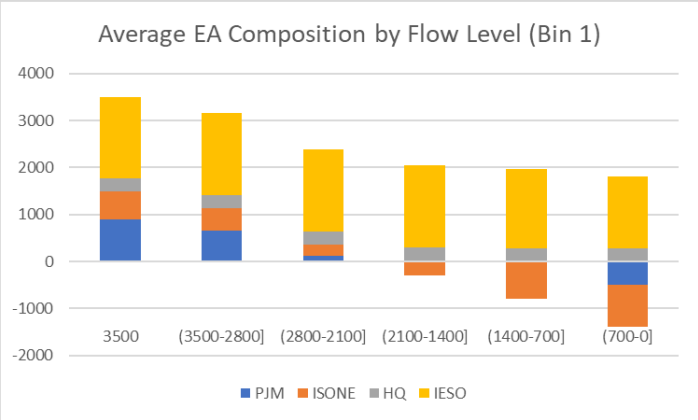
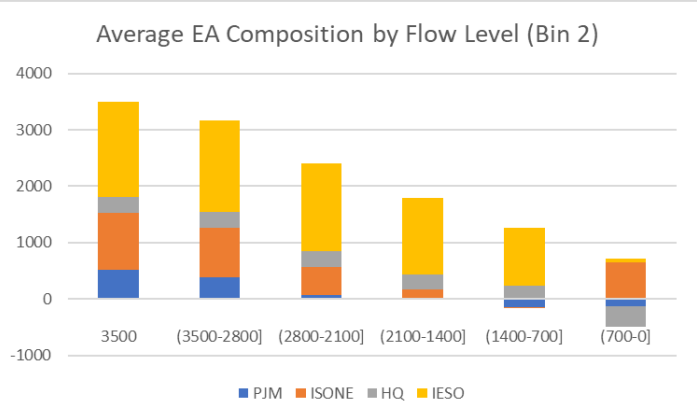
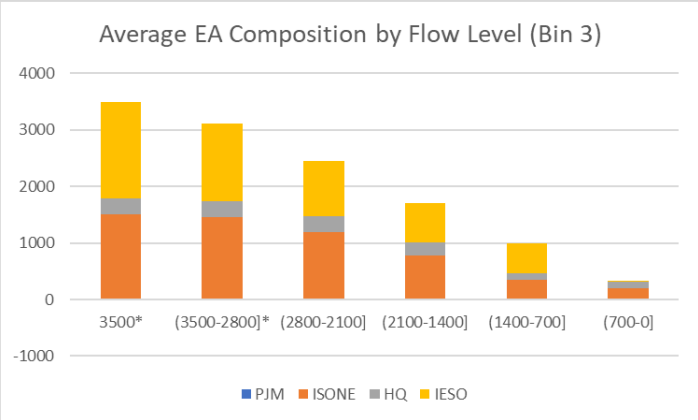
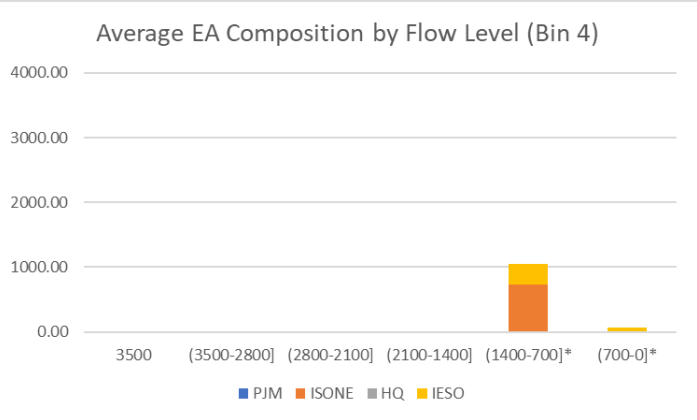
Appendix C2 – 2022 IRM Database EA Flow Composition









*Less than 10 data points

New York ISO

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

New York ISO

Questions?