New York ISO
Independent System Operator

Tan45 Methodology Review

Lucas Carr

NYISO

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Agenda

- **Background**
- **Tan45 Process Overview**
- **Initial Results**
  - Front-of-the Meter (FTM) Solar and Land-Based Wind (LBW)
  - Offshore Wind (OSW)
  - Champlain Hudson Power Express (CHPE)
- **Observations and Next Steps**

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Background

Background

- The Tan45 methodology of establishing the installed reserve margin (IRM) is being reviewed to determine its feasibility under various future scenarios
- The proposed testing plan outlines several of the future scenario cases being evaluated (see slide 5 for a summary of the proposed test cases)
  - These future scenarios include adding expected future transmission projects and supply mix changes to the 2024-2025 IRM study Final Base Case (FBC)
  - The future transmission projects proposed for consideration include implementing Champlain Hudson Power Express (CHPE), Long Island Public Policy Transmission Need (LI PPTN), and Clean Path New York (CPNY) in the model
  - The future supply mix changes proposed for consideration include adding 9,000 MW each of in-front-of-the-meter (FTM) solar, land-based wind (LBW) and off-shore wind (OSW) to the model
- The purpose of today's presentation is to review initial results for several of the test cases and solicit feedback on the results and next steps
  - The initial results are provided for informational purposes only and are intended for use in evaluating the operation of the Tan45 process under various potential future scenarios

Tan45 Review – Summary of Test Cases

Test Case Name	System Scenario	Description
BC	Base Case	2024 – 2025 IRM Final Base Case (23.1% IRM)
TC-T1	Future Transmission Projects	Base Case + CHPE
TC-T2		Base Case + LI PPTN
TC-T3		Base Case + CPNY
TC-T4		Base Case + CHPE, LI PPTN, and CPNY
TC-G1	Increased Renewable Generation Resources	Base Case + 9,000 MW FTM Solar
TC-G2		Base Case + 9,000 MW LBW
TC-G3		Base Case + 9,000 MW OSW
TC-G4		Base Case + 27,000 MW FTM Solar, LBW, and OSW (9,000 MW of each type)
TC-TG5	Future Transmission Projects + Increased Renewable Generation Resources	Base Case + CHPE, LI PPTN, and CPNY + 27,000 MW FTM Solar, LBW, and OSW (9,000 MW of each type)

Cases Being Reviewed Today

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Tan45 Process Overview

Tan45 Methodology Overview

- Policy No.5-17 appendices A & B discuss the Tan45 methodology (Unified Methodology) of establishing the IRM requirements
- The current process establishes a low point IRM by removing capacity only from capacity rich zones east of the Central-East interface (Load Zones A, C, and D) until the 0.100 LOLE criteria is met
  - The Load Zone J and Load Zone K locational capacity requirements (LCRs) are at their as-found levels
- After the low point is established 12 subsequent points which also meet the 0.100 LOLE criteria are established to produce an IRM-LCR curve
  - The 12 subsequent points increase the IRM from the low point by increments of 0.5% (see example below)
  - As the IRM increases from the low point, capacity is shifted upstate from Load Zones J and K in order to maintain the 0.100 LOLE criteria

Point	Low Point	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Point 10	Point 11	Point 12
IRM %	17.20%	17.50%	18.00%	18.50%	19.00%	19.50%	20.00%	20.50%	21.00%	21.50%	22.00%	22.50%	23.00%

- This results in 12 combinations of IRM and LCR values which all meet the 0.100 LOLE criteria
- A regression analysis is then performed on these points to establish an IRM and LCR values at the least volatile point on the curve

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Tan45 Objective and the Changing Grid

- **The objective of the Tan45 methodology is to establish an IRM that balances the locational differences between upstate and downstate, by trading-off between the IRM and LCRs**
  - The NYCA system has historically not been locationally “balanced” with major load centers located downstate and significant surplus generation located upstate
  - Constraints on the transmission system between upstate and downstate also impact how MW can be transferred across the NYCA system
  - The location of supply to serve downstate load centers significantly impacts the IRM
    - Assuming greater reliance on supply located within downstate region to serve the downstate load centers has historically resulted in downward pressure on the IRM
    - Assuming greater reliance on power transfers from the upstate region to serve the downstate load centers has historically placed upward pressure on the IRM
- **Significant changes are expected on the NYCA system that will change the underlying locational differences between upstate and downstate**
  - Renewable generation build out across NYCA, especially the offshore wind build out in downstate, will change the current dynamic of load and surplus generation
  - Transmission infrastructure improvements will also alleviate/lessen some of the known constraints and change patterns of flow across the NYCA system
- **The following test cases perform the current trade-offs between IRM and LCRs, and review how the methodology is affected by the changing grid**
  - Increased penetration of FTM Solar and LBW does not change the underlying locational differences but increases the overall Equivalent Demand Forced Outage Rate (EFORd) of the system resources
  - Increased penetration of OSW results in significant additions of MW in the downstate region, while reducing dependency on thermal resources to serve load
  - CHPE provides a transmission pathway to bypass existing upstate to downstate transfer constraints on the transmission system and inject supply into downstate directly

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Initial Results

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FTM Solar and LBW

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FTM Solar Tan45 Results

- Starting with the 2024-2025 IRM technical study base case (23.1% IRM), 9,000 MW of FTM Solar resources were added utilizing the zonal breakdown below
  - State energy policies call for 10,000 MW of distributed solar resources by 2030
    - Includes behind-the-meter solar resources
  - Current NYISO interconnection queue has ~15,000 MW of solar projects with proposed in-service dates of 2030 or sooner
- The high IRM result is consistent with the findings from prior High Renewable Whitepapers, and is due to higher derating factors of the FTM Solar as compared to thermal resources

Zone	A	B	C	D	E	F	G	H	I	J	K	Total
FTM Solar Additions (MW)	2,632.9	300.0	1,642.6		1,037.8	2,133.9	1,207.1				45.7	9,000.0

Case	IRM	J LCR	K LCR	G-J LCR
BC	23.1%	72.73%	103.21%	84.58%
TC-G1	48.0%	72.70%	103.97%	92.46%

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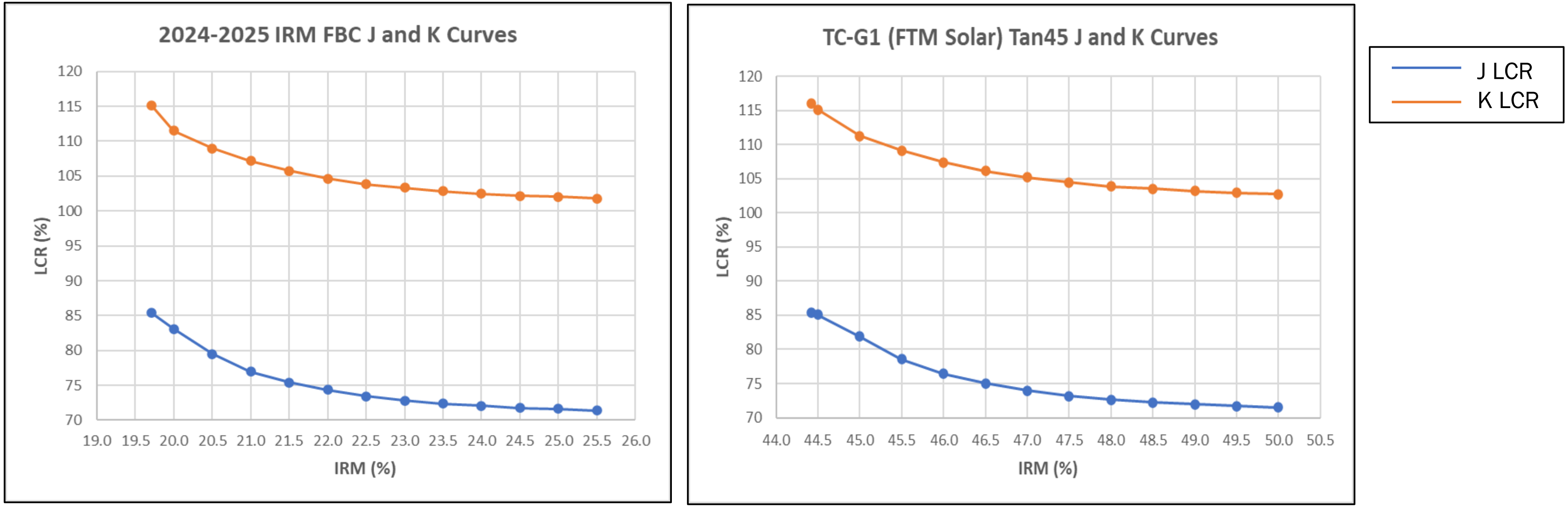
FTM Solar Tan45 Curve Comparison



- There is no considerable change to the shape of the Load Zone J or K curves produced by the Tan45 method and the process is still able to calculate an IRM value with the assumed addition of 9,000 MW of solar resources
- The consistency in the shape of the curves is largely due to the LOLE risk in the model remaining concentrated in summer during the day, when solar has relatively lower derating factor

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LBW Tan45 Results

- Starting with the 2024-2025 IRM technical study base case (23.1% IRM), 9,000 MW of LBW resources were added utilizing the zonal breakdown below
  - Current NYISO interconnection queue has ~3,500 MW of LBW projects with proposed in-service dates of 2028 or sooner
- The high IRM result is consistent with the findings from prior High Renewable Whitepapers, and is due to higher derating factors for the LBW resources compared to thermal resources

Zone	A	B	C	D	E	F	G	H	I	J	K	Total
LBW Additions (MW)	2,345.1	322.1	2,473.4	1807.6	2,051.8							9,000.0

Case	IRM	J LCR	K LCR	G-J LCR
BC	23.1%	72.73%	103.21%	84.58%
TC-G2	44.2%	75.60%	105.37%	86.67%

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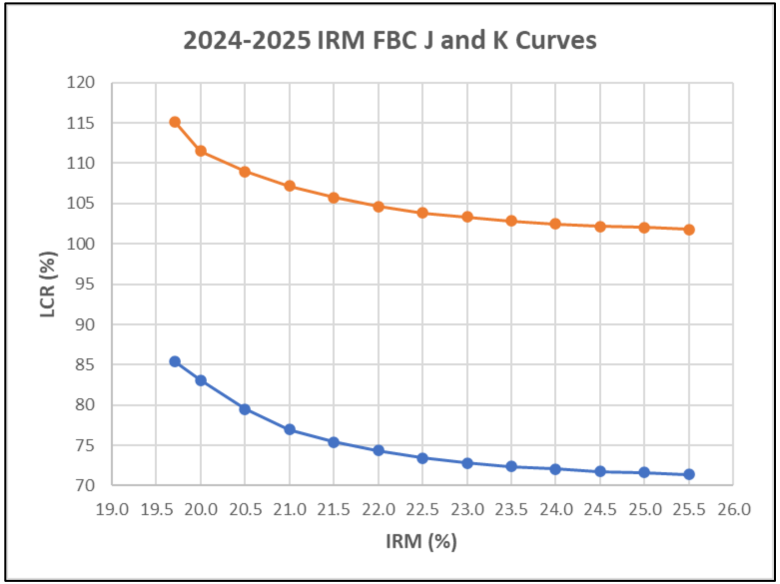
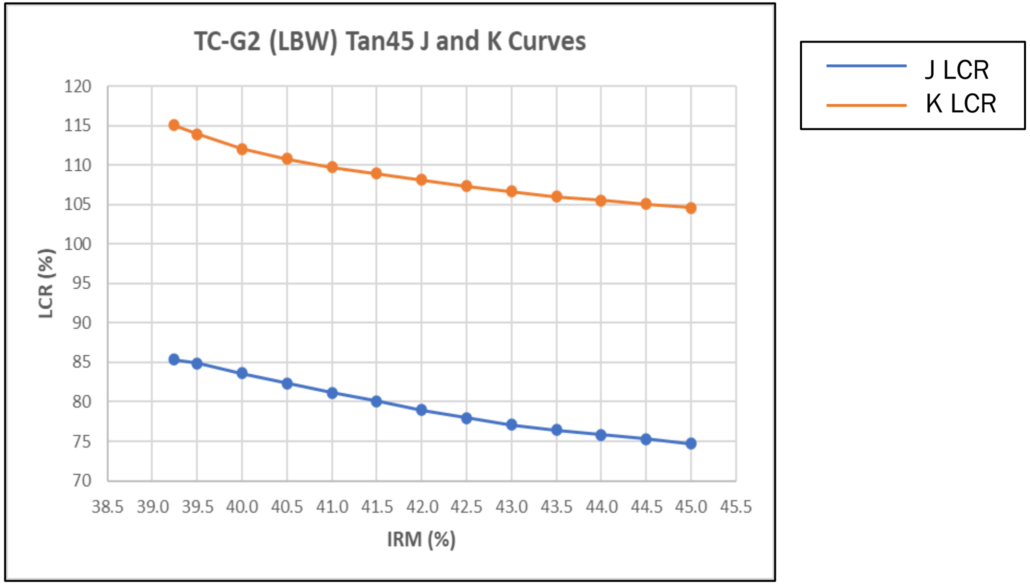
LBW Tan45 Curve Comparison





- The Load Zone J and K curves flatten compared to the 2024-2025 IRM FBC curves, but the process is still able to calculate an IRM value after the addition of the incremental 9,000 MW of land-based wind resources
- The flattened curves are most likely due to a much lower derating factor of LBW being added in upstate, while downstate still has continues to include the majority of the thermal fleet
  - This means that a small movement in the LCRs will mean a much bigger change for IRM, hence flattening the curves

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OSW

OSW Case Setup

- Starting with the 2024-2025 IRM technical study base case (23.1% IRM), 9,000 MW of OSW resources were added utilizing the zonal breakdown below
  - The Climate Leadership and Community Protection Act (CLCPA) requires 9,000 MW of off-shore wind resources by 2035
    - Long Island Public Policy Transmission Need (LI PPTN) will allow for access of at least 3,000 MW of future offshore wind capability into Load Zone K and is expected in-service by 2030
    - New York City PPTN will allow for access of an incremental 4,770 MW of future offshore wind capability, beyond the ~2,000 MW of Load Zone J OSW assumed in the baseline case assumptions, into Load Zone J and is expected in-service by 2033

https://www.nyiso.com/documents/20142/39516587/03_NYCPPT_ESPWG_2023-08-22.pdf/c4ebb258-6d45-effb-e9e1-635edfc50aef

Zone	Added ICAP (MW)	Translation Factor	Added UCAP (MW)
J	6,000.0	37.1%	2,225
K	3,000.0	39.7%	1,191
Total	9,000.0	38.0%	3,416

Area	Base Case EFORd	OSW Case EFORd	Delta
A - F	18.12%	18.12%	-
J	6.27%	29.26%	22.99%
K	12.49%	30.09%	+17.60%
G - J	9.17%	25.71%	+16.55%

OSW Tan45 Results

- The Tan45 process was not able to calculate a Tan45 IRM result that fit all of the criteria as described in Policy No. 5-17 with the addition of 9,000 MW of OSW
- The Load Zone J and K LCR values drop significantly from the low point (of IRM) to the first point and then begin to flatten out more than has been observed in recent IRM studies
- The large drop in Load Zone J and K LCR values from the low point to the first point seems to be due to capacity being less valuable to system LOLE in Load Zones J and K than upstate, indicating that removing MW from Load Zones A, C and D may not produce the actual low point for the IRM
  - This is different from current conditions where Load Zones J and K are always more valuable to system LOLE after establishing the low point
- This change is driven by adding large amounts of capacity in Load Zone J and K, and is not specific to such capacity being offshore wind

Point	IRM	J LCR	K LCR
Low Point	39.99	139.098	174.121
1	40.50	112.938	150.973
2	41.00	112.577	150.249
3	41.50	112.413	149.478
4	42.00	112.056	148.899
5	42.50	111.786	148.408
6	43.00	111.661	148.119
7	43.50	111.536	147.921
8	44.00	111.535	147.635
9	44.50	111.470	147.364
10	45.00	111.459	147.145
11	45.50	111.412	146.935
12	46.00	111.368	146.722

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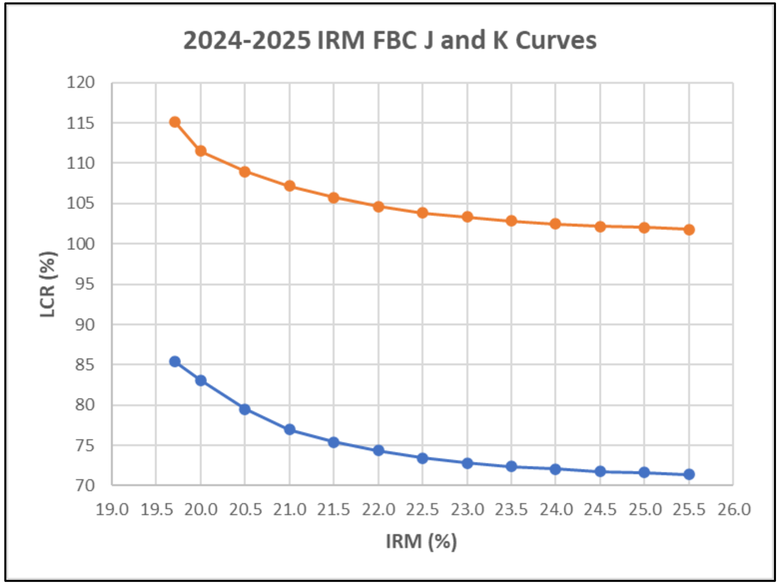
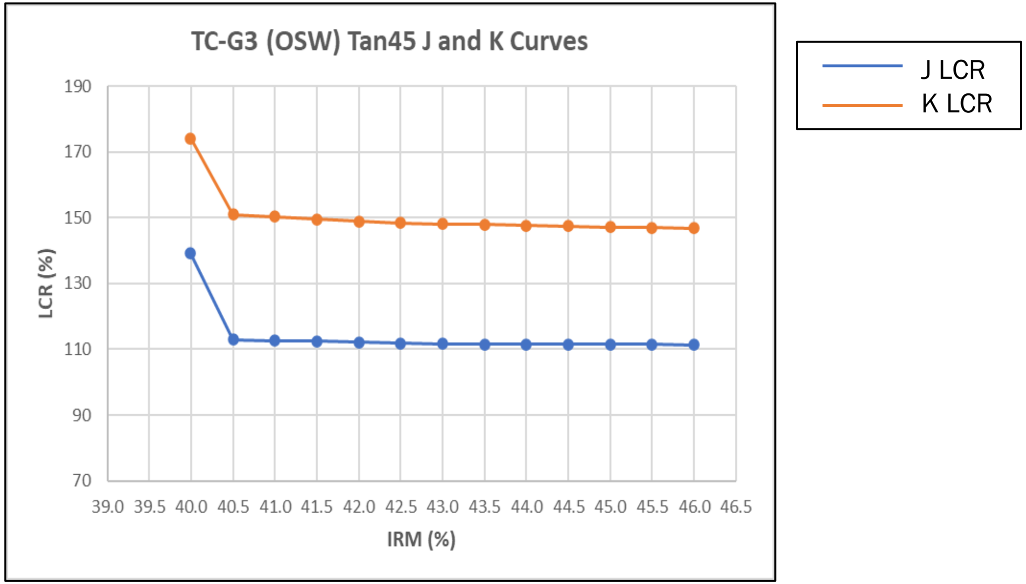
OSW Tan45 Curve Comparison





- The Load Zone J and K curves are drastically different compared to the current curves and show a large drop from the low point to the first point and then a flattening out for the additional points beyond that

CHPE

CHPE Case Setup

- Starting with the 2024-2025 IRM technical study base case (23.1% IRM), CHPE was added to the model
  - 1,250 MW transmission project connecting Hydro-Québec (HQ) to Load Zone J
- CHPE modeling assumptions
  - 1,250 MW connection from HQ to Load Zone J backed by a 1,250 MW Unforced Capacity Deliverability Rights (UDR) resource located in a dummy zone modeled within the NYCA system
    - Modeling is similar to other external transmission lines with UDR resources where the transmission line is available to provide emergency assistance in the event of the UDR being on outage
  - The UDR resource was assumed to have an EFORd of 4.54% (NERC class average for hydro resources) and the transmission line was assumed to have an outage rate of 5% (5 Year Average Cable Outage Rate for 2018-22 from 2024-2025 IRM Final Base Case Model Assumptions Matrix = 4.83%)
  - The emergency assistance allowances were not adjusted from the values established in last year's EOP Review Whitepaper Report

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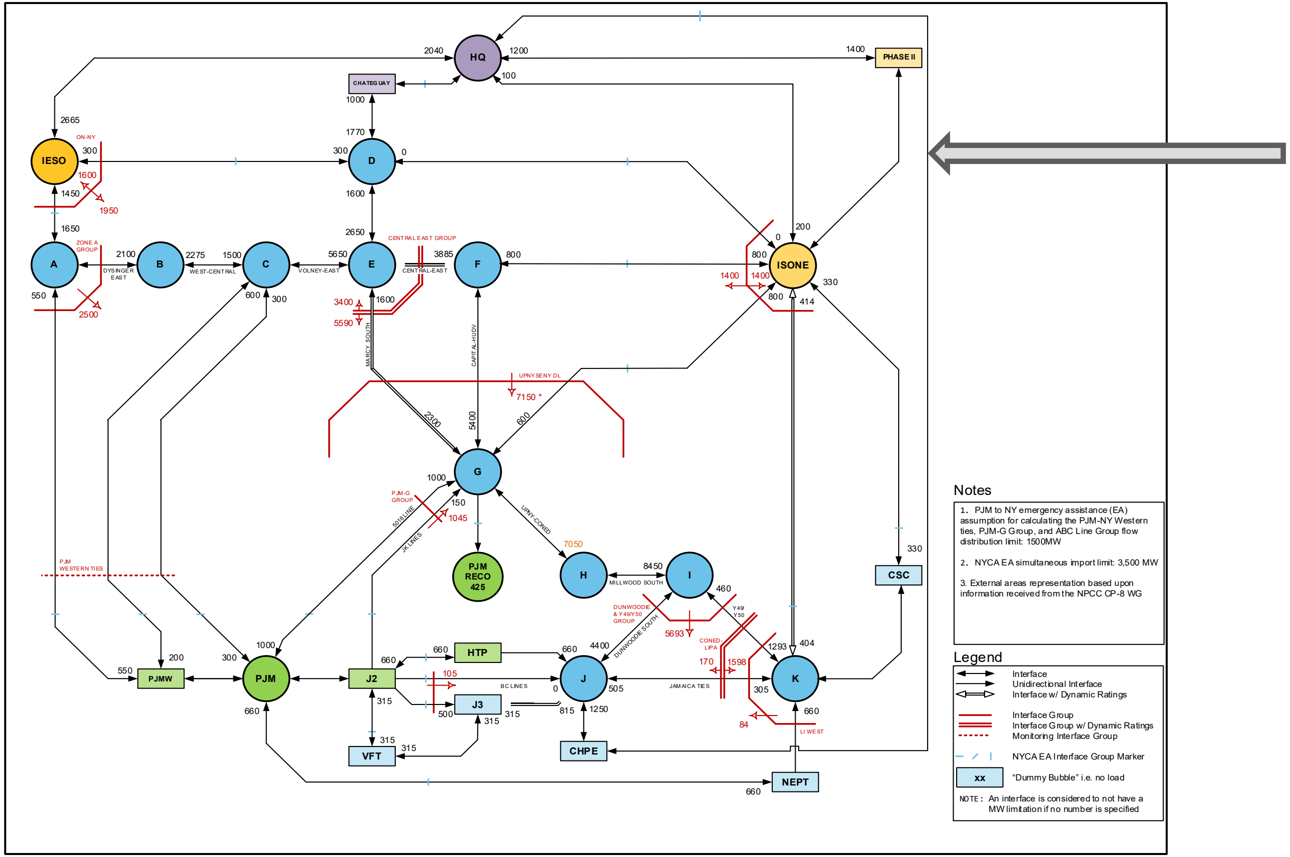
CHPE Topology Setup



CHPE Tan45 Results

- The Tan45 process was able to calculate an IRM value, but the addition of CHPE does have significant impacts on the shape of the Load Zone J curve compared to the 2024-2025 IRM study
- The addition of 1,250 MW of capacity with the UDR shifts the low point Load Zone J LCR up and then the curve is much steeper as the additional 12 Tan45 points are established (see slide 23)
  - The NYISO recommends conducting additional analysis to further evaluate the effectiveness of the Tan45 process in establishing the IRM and the reasonableness of the resulting IRM with the addition of CHPE

Case	IRM	J LCR	K LCR	G-J LCR
BC	23.1%	72.73%	103.21%	84.58%
TC-T1	23.2%	76.09%	102.18%	87.04%

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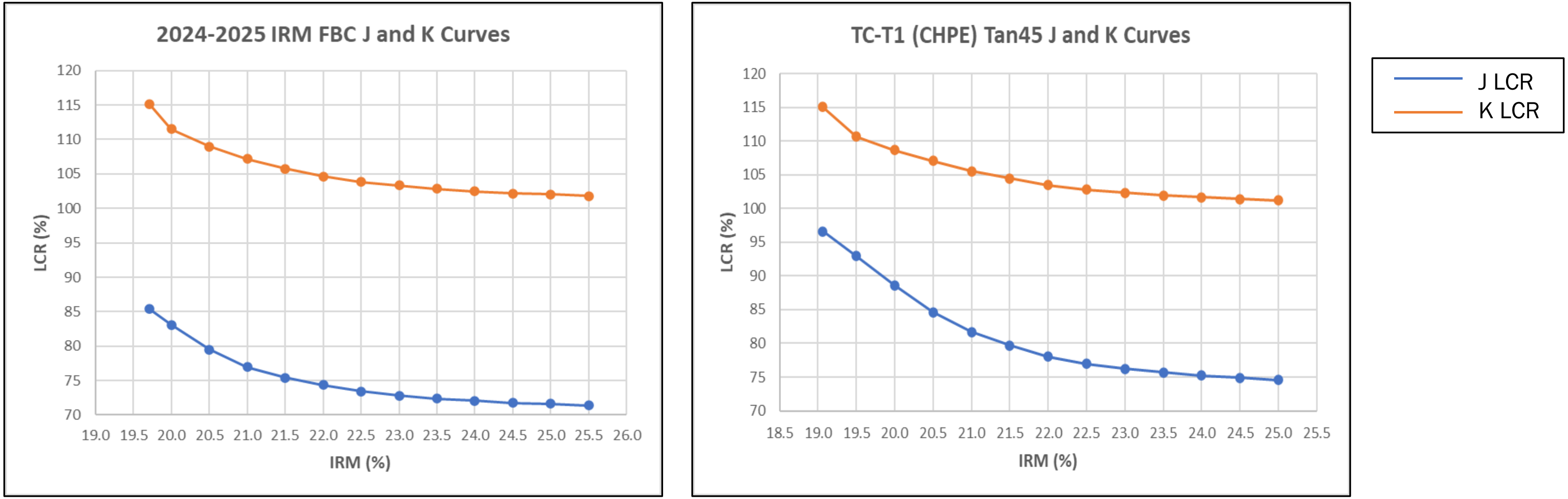
CHPE Tan45 Curve Comparison



- The Load Zone J LCR curve starts higher due to the addition of the 1,250 MW UDR and the curve drops much more significantly along the curve as the 12 points are established
  - The NYISO is continuing to evaluate these outcomes to identify any potential concerns

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Observations and Next Steps

Observations

- When adding capacity in the upstate region where generation has historically been in surplus, the original locational differences that the Tan45 methodology aims to balance remain unchanged
  - However, the higher derating factor of the renewable resources compared to thermal resources will result in flattening of the curves making the IRM outcome from the Tan45 methodology potentially less stable, predictable and/or logical
- Adding capacity in load centers changes the original locational differences between upstate and downstate, resulting in conditions that can cause the Tan45 methodology to fail to establish a balanced IRM
  - Removing MW from Load Zones A, C and D no longer leads to a low point IRM with the addition of significant incremental MW in Load Zones J and K; shifting MW between upstate (Load Zones A, C, D) and downstate (Load Zones J and K) does not represent real tradeoffs between IRM and locational requirements under such system conditions
- The test case with CHPE requires further review as the initial results do not appear to represent the impact of improvement to the transmission system
  - Additional analysis conducted in the 2024-2025 IRM Preliminary Base Case (PBC) showed that when improving transfer into downstate, the Tan45 curve would be lowered (ICS Presentation)
- Additional factors beyond the capability of the Tan45 process to successfully calculate an IRM value should continue to be evaluated to ensure that the results remain reasonable under changing system conditions

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Next Steps

- The NYISO will continue developing the remaining future scenario cases outlined in the testing plan and anticipates providing additional results at the 6/5/2024 ICS
- The results will continue to be evaluated to better determine when issues could potentially start to arise

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

Questions?