Tan45 Methodology Review

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NYISO

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Agenda

- Background
- Additional Analysis: Sensitivity Case No. S-2
- Phase 2 Scope Development
- Next Steps
- Appendix
  - Past Results

Background

Background

- The Tan45 methodology of establishing the Installed Reserve Margin (IRM) is being reviewed to determine its operation under various future scenarios
- 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 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 include adding up to 9,000 MW each of in-front-of-the-meter (FTM) solar, land-based wind (LBW) and offshore wind (OSW) to the model

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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 Tan45-determined locational capacity requirements (LCRs)
  - The New York Control Area (NYCA) system has historically not been locationally "balanced" with significant surplus generation located upstate and major load centers located downstate
  - 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 impact 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
- A series of test cases were developed to review how the Tan45 methodology may be impacted by the changing grid (see Appendix for full list of cases). The results to date, generally, show that:
  - 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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Tan45 Methodology Overview

- Appendices A and B of Policy No.5-18 discuss the Tan45 methodology (also known as the "Unified Methodology") of establishing the IRM requirements
- The current process establishes a low point IRM by removing capacity only from capacity rich zones west 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 LCRs are at their "as-found" levels
- After the low point is established 12 subsequent points that 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 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%

- The result is 12 combinations of IRM and LCR values that 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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Additional Analysis: Sensitivity Case No. S-2

Case S-2: Additional Analysis - Capacity Shifting

- Analysis of the Tan45 methodology was conducted to identify areas with similar reliability risk
- Starting with the as-found system, perfect capacity was removed from each zone separately until the 0.1 LOLE criteria was met
    - Note: Not all zones had as much perfect capacity in the as-found system as was removed to achieve the 0.1 LOLE criteria, negative capacity was allowed for the comparison across all zones
    - The capacity removed to establish the Tan45 low point based on excess capacity is also shown for comparison
- Capacity levels reflect as-found levels of risk and deliverability of supply in neighboring areas
- Removals from Load Zone A lead to NYCA converging to 0.1 faster than from removal from other zones

Central East (border between Zones E and F)

Load Zone	A	B	C	D	E	F	G	H	I	J	K
Perfect Capacity Removed	1,200	1,195	3,820	2,257	4,608	4,618	4,620	3,934	3,934	3,360	1,104
Tan45 Low Point Capacity Removed	305	0	3,443	2,100	0	0	0	0	0	0	0
Excess Capacity Modeled	246	-1,338	2,772	1,690	-911	1,811	1,799	-592	-1410	108	880

As the system topology evolves with new generation resource additions and transmission expansion, certain key assumptions used in the current Tan45 methodology key assumptions warrant reconsideration, such as:

1) Does Central East remain the border from which to shift?
2) Is excess UCAP a reasonable metric upon which to shift?
    - If not, what other metrics should be considered to inform capacity shifts used to find the anchor of the IRM/LCR curves?

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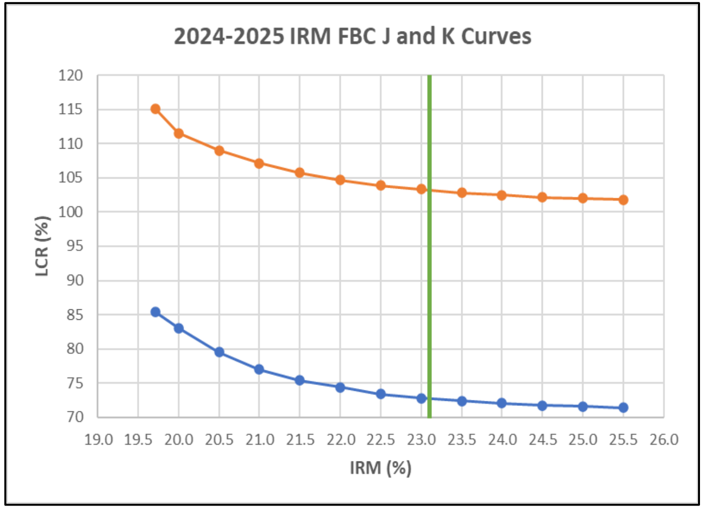
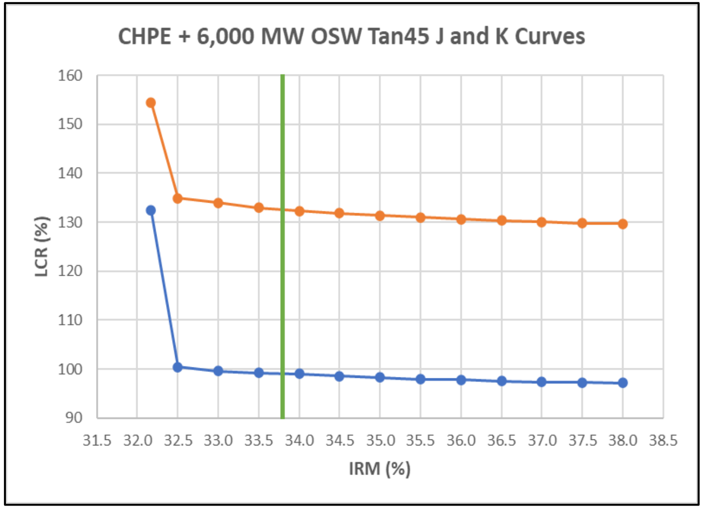
Case S-2 (CHPE + 6,000 MW OSW): Results Overview





- Tan45 was able to calculate a solution
- IRM/LCR curve is flattening, and the "knee of the curve" is no longer visually distinct
- Beyond the low point, as the IRM increases, very small decreases to the LCRs bring the system back to 0.1 LOLE

Case	IRM	J LCR	K LCR	G-J LCR
Base Case (BC)	23.1%	72.73%	103.21%	84.58%
CHPE + 6,000 MW OSW	33.8%	99.04%	132.57%	103.82%

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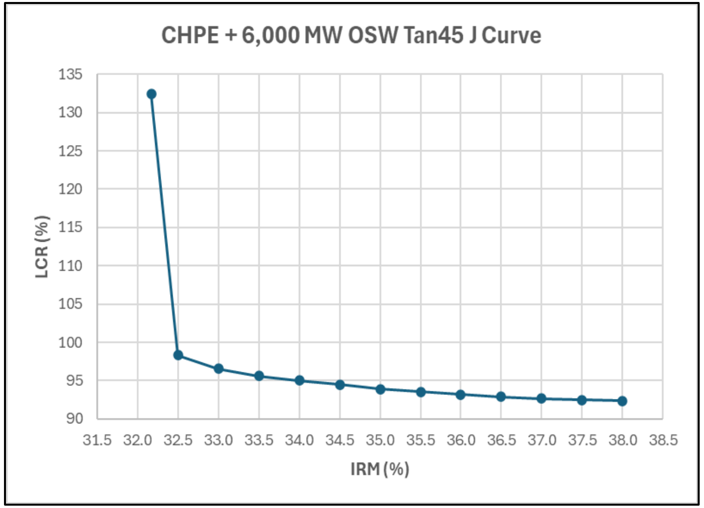
Case S-2: Further Curve Analysis – Load Zone J LCR Curve

Point on Curve	MWs Removed from Load Zones A, C, and D	MWs Removed from Load Zone J	Total MWs Removed	IRM (%)	J LCR (%)
Low Point	5,849	0	5,849	32.2%	132.4%
1	1,938	3,805	5,743	32.5%	98.3%
2	1,580	4,004	5,585	33.0%	96.5%
3	1,319	4,107	5,426	33.5%	95.6%
4	1,095	4,172	5,267	34.0%	95.0%
5	872	4,236	5,108	34.5%	94.5%
6	648	4,301	4,949	35.0%	93.9%
7	450	4,340	4,790	35.5%	93.5%
8	250	4,381	4,632	36.0%	93.2%
9	60	4,413	4,473	36.5%	92.9%
10	-122	4,436	4,314	37.0%	92.7%
11	-303	4,458	4,155	37.5%	92.5%
12	-474	4,471	3,996	38.0%	92.4%



- As you move from the low point to point 1, a significant amount of capacity is shifted from Load Zone J to Load Zones A, C, and D to bring the system back to the 0.1 LOLE criteria
  - Caused by Load Zone J capacity providing less reliability to the system than capacity in Load Zones A, C, and D until a breaking point/threshold is met where Load Zone J capacity provides more reliability to the system again
- Beyond point 1 where that breaking point/threshold has been met, very little additional capacity is shifted from Load Zone J to bring the system back to 0.1 LOLE as you move along the curve
  - Results in a very flat curve along which relatively small changes in the Load J LCR values can lead to material increases to the IRM

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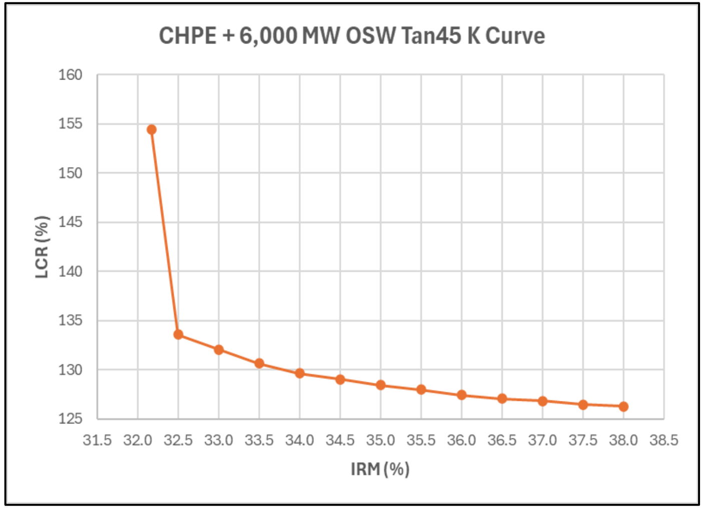
Case S-2: Further Curve Analysis – Load Zone K LCR Curve

Point on Curve	MWs Removed from Load Zones A, C, and D	MWs Removed from Load Zone K	Total MWs Removed	IRM (%)	K LCR (%)
Low Point	5,849	0	5,849	32.2%	154.4%
1	4,684	1,059	5,743	32.5%	133.6%
2	4,447	1,138	5,585	33.0%	132.0%
3	4,216	1,210	5,426	33.5%	130.6%
4	4,006	1,261	5,267	34.0%	129.6%
5	3,816	1,292	5,108	34.5%	129.0%
6	3,628	1,321	4,949	35.0%	128.4%
7	3,446	1,344	4,790	35.5%	128.0%
8	3,258	1,374	4,632	36.0%	127.4%
9	3,082	1,391	4,473	36.5%	127.1%
10	2,911	1,403	4,314	37.0%	126.8%
11	2,734	1,422	4,155	37.5%	126.5%
12	2,564	1,432	3,996	38.0%	126.3%



- The impact on the Load Zone K LCR curve is similar to the impact observed for the Load Zone J LCR curve
- The observed impacts to the Load Zones J and K LCR curves indicate that fundamentals of the Tan45 process are not functioning as intended under the system conditions represented in Case No. S-2
  - The first point on the IRM/LCR curve is intended to represent the “maximum possible LCR at lowest possible IRM” but this is not the case under the assumed system conditions represented by Case No. S-2

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Phase 2 Scope Development

Phase 2 Scope Development

- Phase 2 of this whitepaper will explore potential alternative methodologies and/or enhancements to the current Tan45 methodology. Some key considerations that should be explored in the next phase include:
  - What guiding principles from the current Tan45 process should be maintained when exploring alternative methodologies/enhancements?
    - Further background information regarding the considerations/principles in adopting the Tan45 methodology were reviewed in the August 3, 2006 presentation to the Resource Adequacy Issues Task Force (Slide 22 in the Appendix provides a summary of the guiding principles):
      - https://www.nyiso.com/documents/20142/1398547/RAITF_tan45_vs_FFE_080106.pdf
  - How should locational trade-offs be considered as the NYCA system shifts from its current dynamics?
- Potential alternative methodologies/enhancements that could be explored in Phase 2, considering key principles identified to guide such considerations:
  - Incorporating the transmission security limit (TSL) floor values in the Tan45 process
  - Leveraging the NYISO's Locational Minimum Installed Capacity Requirements optimization methodology (LCR Optimizer) – Link to LCR Determination Process
    - Currently utilized by the NYISO following the IRM approval by the NYSRC to determine the LCRs for the Load Zone J, Load Zone K and the G-J Locality
- Request feedback from the Installed Capacity Subcommittee (ICS) on additional alternative methodologies/enhancements that should be considered as part of Phase 2

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Next Steps

Next Steps

- Continue conducting additional analysis on the test cases previously presented to ICS
  - Further research into what is driving the flattening of the curve
  - Identify key trends and system changes that are leading to challenges for the current Tan45 process to compute results
- Further conversations to identify key principles to evaluate alternatives and/or enhancements
- Continue refining Phase 2 of this project for 2025 to finalize the intended scope
  - Recommend the potential need to consider developing interim measures in the event the current Tan45 process encounters conditions that presents challenges in producing results

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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

Previous Discussions

- 1/30/2024 ICS: Tan45 Methodology Review Whitepaper Scope
  - https://www.nysrc.org/wp-content/uploads/2024/02/Tan45-Methodology-Whitepaper-Scope-01302024-ICS-REVISED27280.pdf
- 2/27/2024 ICS: Tan45 Methodology Review
  - https://www.nysrc.org/wp-content/uploads/2024/02/Tan45-Methodology-Review-02272024-ICS28519.pdf
- 4/3/2024 ICS: Tan45 Methodology Review
  - https://www.nysrc.org/wp-content/uploads/2024/03/Tan45-Methodology-Review-04032024-ICS30726.pdf
- 5/1/2024 ICS: Tan45 Methodology Review
  - https://www.nysrc.org/wp-content/uploads/2024/04/Tan45-Methodology-Review-05012024-ICS30948.pdf
- 6/5/2024 ICS: Tan45 Methodology Review
  - https://www.nysrc.org/wp-content/uploads/2024/06/Tan45-Methodology-Review-06052024-ICS33405.pdf
- 6/26/2024 ICS: Tan45 Methodology Review
  - https://www.nysrc.org/wp-content/uploads/2024/06/Tan45-Methodology-Review-06262024-ICS33552.pdf

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Testing Plan

Test Case Name	System Scenario	Description	Presented At:
BC	Base Case	2024 – 2025 IRM Final Base Case (23.1% IRM)	Base Case
TC-T1	Future Transmission Projects	Base Case + CHPE	5/1/2024 ICS
TC-T2		Base Case + CHPE and LI PPTN	
TC-G1	Increased Renewable Generation Resources	Base Case + 9,000 MW FTM Solar	5/1/2024 ICS
TC-G2		Base Case + 9,000 MW LBW	5/1/2024 ICS
TC-G3		Base Case + 9,000 MW OSW	5/1/2024 ICS
TC-TG4	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)	
S-1	Sensitivities	Base Case + CHPE + 3,000 MW OSW	6/5/2024 ICS
S-2		Base Case + CHPE + 6,000 MW OSW	6/5/2024 ICS
S-3		Base Case + CHPE + LI PPTN + 9,000 MW OSW	

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Founding Principles of Tan45 Method

Principles for Selecting an Anchor (*2006, Resource Adequacy Task Force)*

Compliance with Reliability Rules

Physical Considerations

- Feasible

- Reflective of Current System Configuration

- Compatible with Zonal LOLE results

Stability of Anchor Point

- Avoid small changes in IRM resulting in large changes to LCR

- Importance of computing IRM/LCR relationship as accurately as possible

Economic Considerations

- Minimizes the delivered cost to the New York consumer at an acceptable level of reliability

- Price signals

- https://www.nyiso.com/documents/20142/1398547/RAITF_tan45_vs_FFE_080106.pdf/49a8db5c-0cce-7aaa-7dc8-ad1abcf5eae8
- “Tan 45” Anchor versus Free Flowing Equivalent for Establishing Statewide IRM Resource Adequacy Issues Task Force Meeting August 3, 2006

Past Results

Information presented at the 5/1/2024 and 6/5/2024 ICS meetings

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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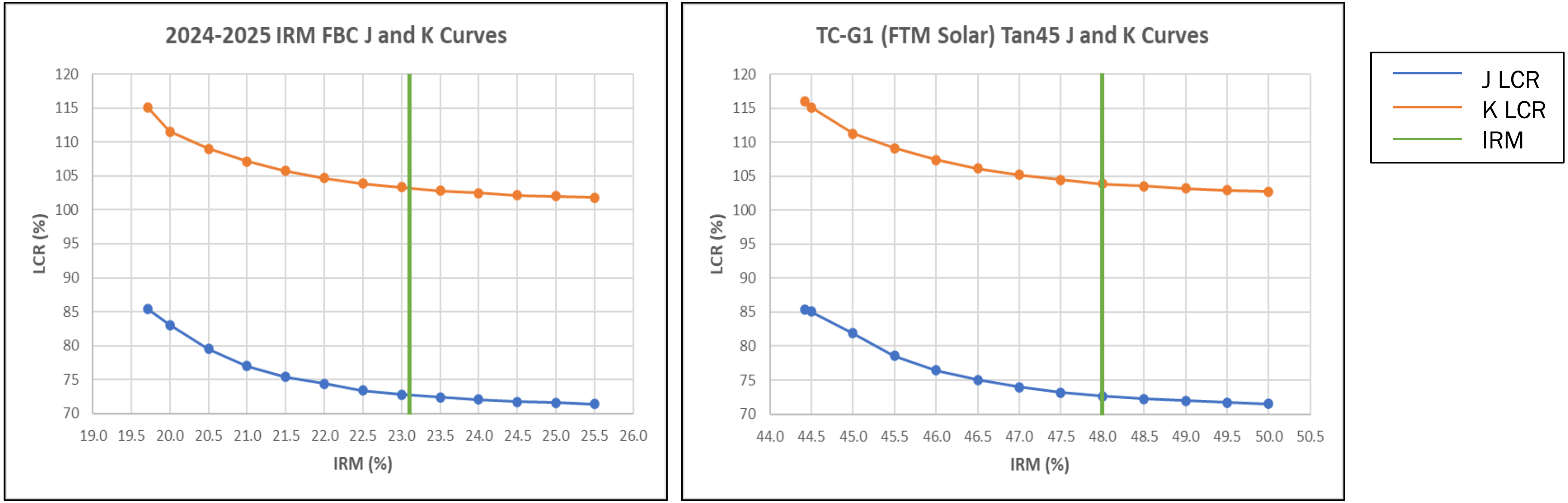
FTM Solar Tan45 Curve Comparison



- 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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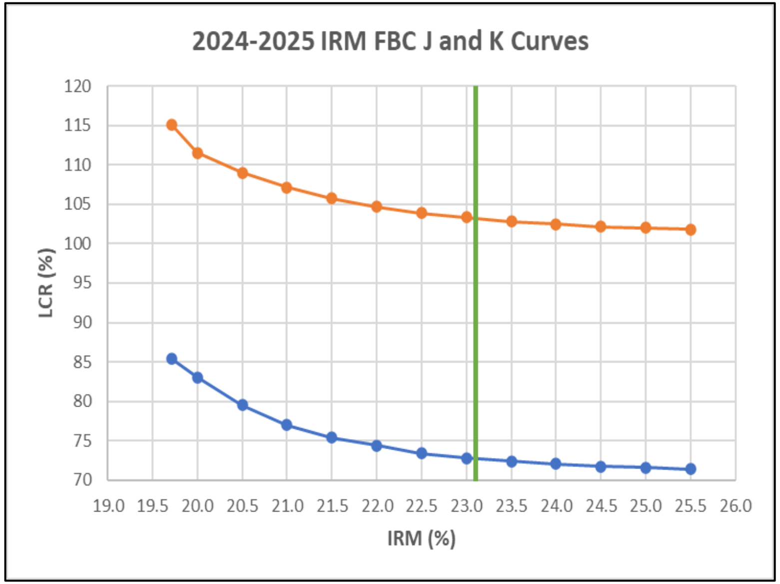
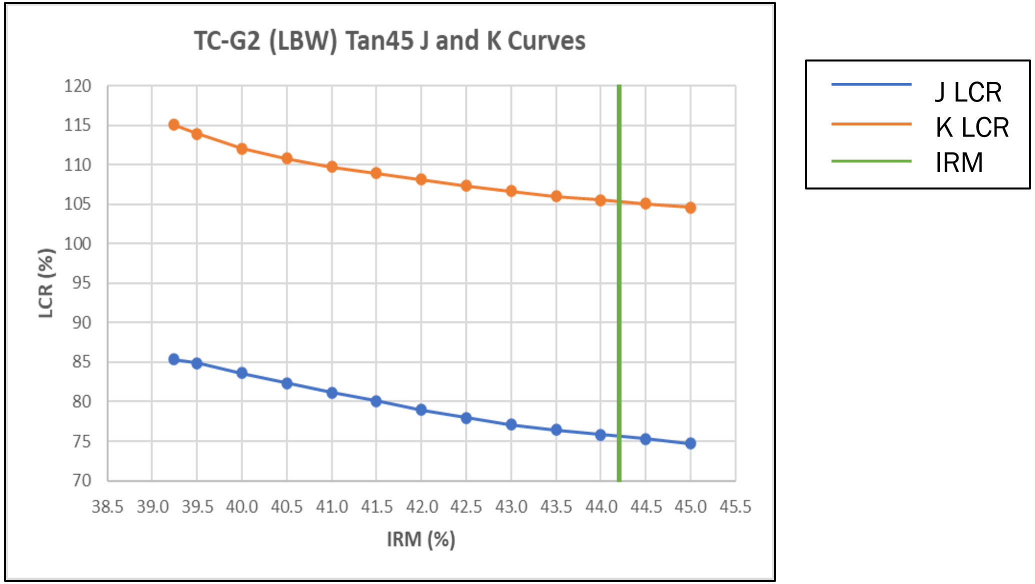
LBW Tan45 Curve Comparison





- 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 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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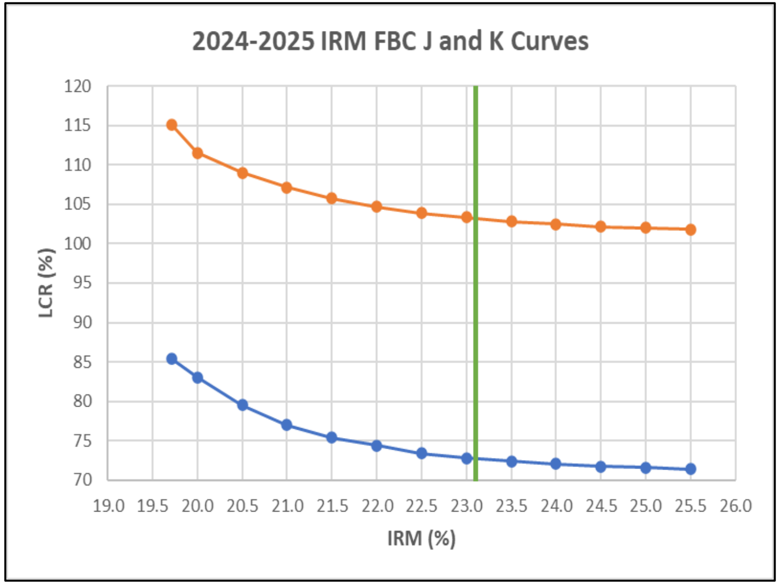
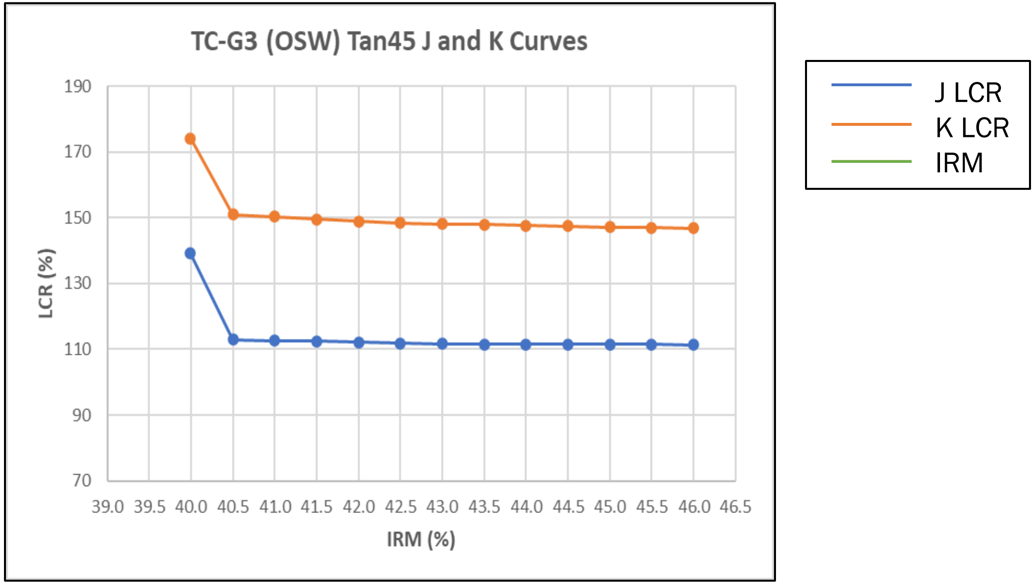
OSW Tan45 Curve Comparison





- 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

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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 next slide)
  - 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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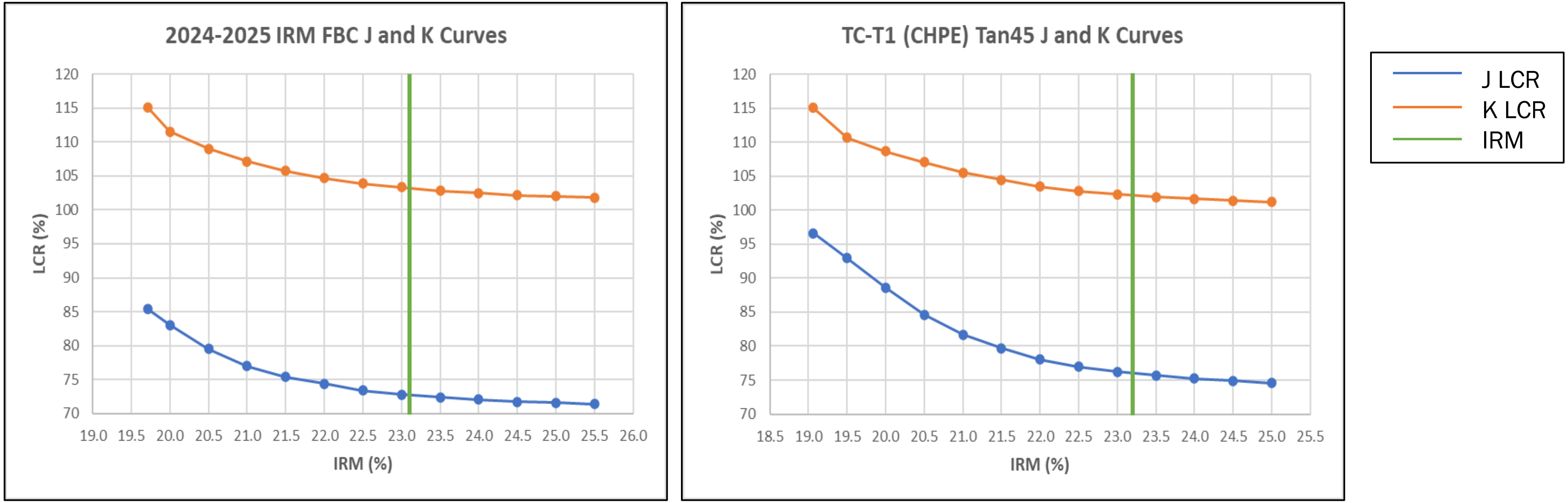
CHPE Tan45 Curve Comparison



- 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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CHPE + 3,000 MW OSW Results

Case	IRM	J LCR	K LCR	G-J LCR
Base Case (BC)	23.1%	72.73%	103.21%	84.58%
CHPE + 3,000 MW OSW	28.2%	86.40%	116.01%	94.58%

- The Tan45 process was able to calculate an IRM result that met all Policy No. 5 criteria
- The increase to the IRM and LCRs were expected due to higher derating factors for the OSW resources compared to thermal resources and increased capacity added to Load Zones J and K

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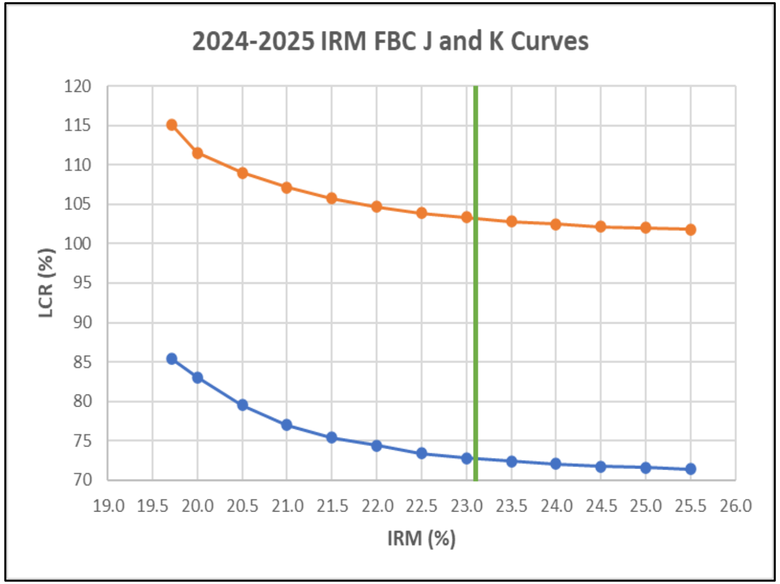
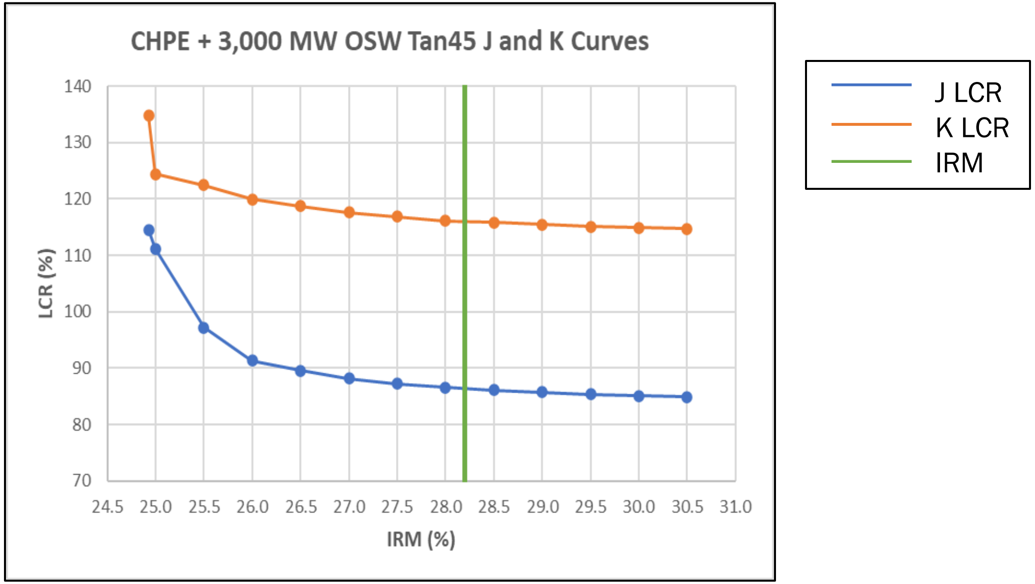
CHPE + 3,000 MW OSW Curve Comparison





- The curves are much steeper for the first few Tan45 points and then start to flatten out more compared to 2024-2025 IRM FBC curves
- Appears to be driven by the large addition of capacity into downstate resulting in a shift to the historical locational differences present on the system

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CHPE + 6,000 MW OSW Results

Case	IRM	J LCR	K LCR	G-J LCR
Base Case (BC)	23.1%	72.73%	103.21%	84.58%
CHPE + 6,000 MW OSW	33.8%	99.04%	132.57%	103.82%

- The Tan45 process was able to calculate an IRM result that met all Policy No. 5 criteria
- The increase to the IRM and LCRs were expected due to higher derating factors for the OSW resources compared to thermal resources and increased capacity added to Load Zones J and K

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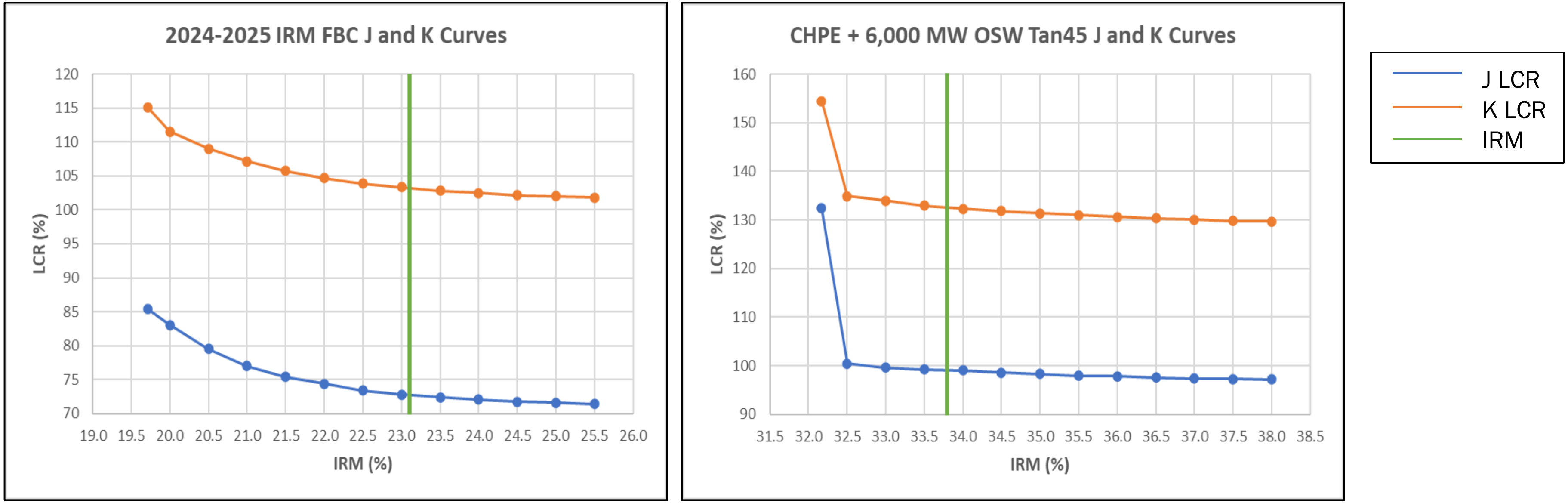
CHPE + 6,000 MW OSW Curve Comparison



- The curves are even steeper than the CHPE + 3,000 MW OSW case (S-1) highlighting that the issue of flattening of the Load Zone J and K curves is exacerbated as more capacity is added to Load Zones J and K
- The large drop from the low point to the first Tan45 point was present in the OSW test case (TC-G3) and appears to be due to capacity being less valuable to system LOLE in Load Zones J and K than upstate

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