Tan45 Methodology Review

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NYISO

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Agenda

- Background
- Alternative Low Point Analysis
- Unforced Capacity Reserve Margin (URM) Analysis
- Offshore Wind (OSW) Results: Additional Analysis
- Next Steps
- Appendix
  - Past Results

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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 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 offshore wind (OSW) to the model

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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	

- **The testing plan has been updated to reflect the discussion at the 6/5/2024 ICS meeting**

Alternative Low Point Analysis

Establishing the Low Point

- The low point is currently established by removing capacity from Load Zones A, C, and D and leaving the rest of the system as-found
  - This establishes what is intended to be the lowest possible IRM value while the locational capacity requirement (LCR) values will be at their maximum
  - The selection of Load Zones A, C and D for capacity removal was to respect the constraint of the Central-East interface, as noted in the Policy 5
- While conducting certain future scenario tests where significant incremental capacity was added primarily downstate (e.g., test cases TC-G3 and S-2 [see Slide 5]), it was observed that the current process to establish the low point no longer appears to operate as intended
  - Further testing was conducted to analyze this observation

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Alternative Low Point Tests

- The NYISO attempted alternative shifting methodologies to try to find IRM values that were lower than the low point established with the current Tan45 process that still met the loss of load expectation (LOLE) criteria
  - The alternatives attempted to remove capacity from Load Zones A, C, D, J and K in varying ratios to evaluate if a lower IRM value could be produced if the LCRs were allowed to shift as well

TC-G3 (9,000 MW OSW)	Tan45 Low Point	Alternative "Low Point"	Delta
IRM	39.99%	38.94%	-1.10%
J LCR	139.10%	122.29%	-12.79%
K LCR	174.12%	156.76%	-13.36%
LOLE	0.100	0.100	-

S-2 (CHPE + 6,000 MW OSW)	Tan45 Low Point	Alternative "Low Point"	Delta
IRM	32.16%	31.34%	-0.83%
J LCR	132.38%	116.46%	-15.92%
K LCR	154.44%	142.35%	-12.09%
LOLE	0.100	0.100	-

- In both test cases, the alternative shifting, which allowed the LCRs to be reduced from their as-found values, produced lower IRM values than the Tan45 low point using the current method
  - The alternative shifting methods tested were just one of many possible methodologies and may not be the optimal solution to find the lowest IRM value shifting between these areas

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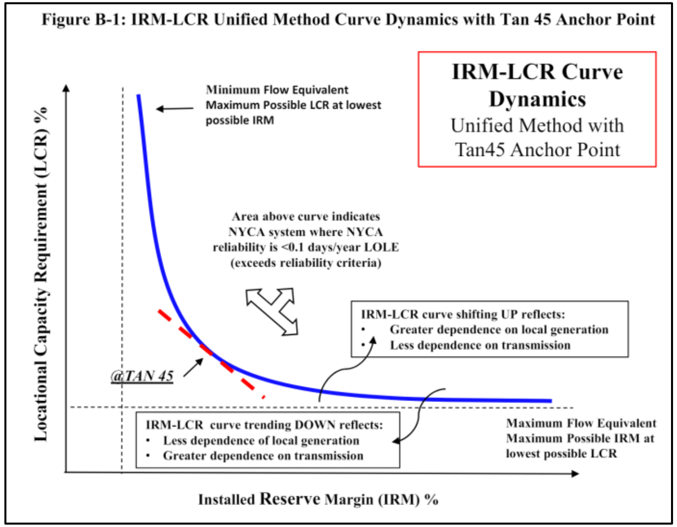
Observations

- The alternative low point analysis shows that the curve dynamics of the current Tan45 methodology may not operate as intended in certain future scenarios with significant resource additions downstate
- As shown on the chart from Policy 5, the first point is intended to be the "Maximum Possible LCR at lowest possible IRM," but this is no longer the case under the future scenarios tested where capacity has been added in large quantities to the downstate areas
- Certain key considerations also emerged while performing this analysis:
  - How to consider locational trade offs in the Tan45 process if the original curve dynamics no longer work?
    - Policy 5 currently defines Central-East as the boundary that separates upstate and downstate, and MW is traded off across the boundary in the Tan45 process
  - What principles should be considered in the shifting methodology for establishing the low point?
    - For example, under the current boundary definition, Load Zone F is not considered when removing capacity from upstate using the current shifting methodology because it is east of the Central-East interface



https://www.nysrc.org/wp-content/uploads/2023/12/NYSRC-Policy-5-17_Final-5_12_23-w_errata.pdf

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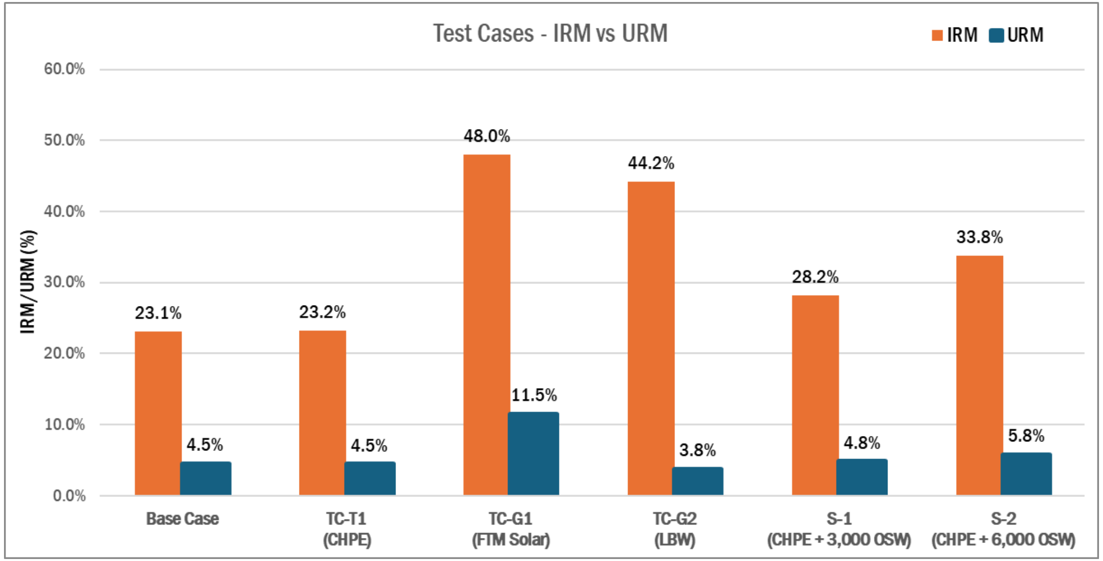
URM Analysis

URM Analysis

- In previous discussions, ICS has expressed interest in reviewing the URM for the future scenario cases that have been conducted
- The location where the capacity was added seems to be the driver for the large differences between the URM for the FTM Solar (TC-G1) and LBW (TC-G2) cases
  - For TC-G2, the assumed location of additions more closely aligned with where capacity is removed in the current Tan45 shifting methodology, which may lead to this observation
- Further analysis will be conducted to better understand these results



OSW Results: Additional Analysis

Downstate OSW Impacts

- In previous testing, a noticeable flattening of the Load Zone J and Load Zone K curves occurred in the 9,000 MW OSW test case (TC-G3)
- Due to the scaling of the charts, it was difficult to compare the base case to the OSW test case and determine potential issues leading to the inability of the Tan45 to produce an IRM for this test case
  - The NYISO adjusted the charts to more easily compare the results
- The charts on the Slide 14 show the amount of additional MW shifted out of Load Zones J and K from the prior Tan45 point to maintain the target LOLE as the IRM increases
  - The low point was excluded from these charts because this point is determined with Load Zones J and K at “as-found” levels and therefore would have 0 MW shifted out of each zone
  - Point 1 was also excluded from the charts because the IRM change from the low point may not be 0.5% as is the case for all the other points along the curve
- The charts on Slide 15 compare the MW capacity requirements along the Tan45 curve adjusting the starting point and axis to better align the scaling in each case
  - The low point was excluded from these charts to remove the effects of the large drop in LCRs in the TC-G3 (OSW) case from the low point to point 1

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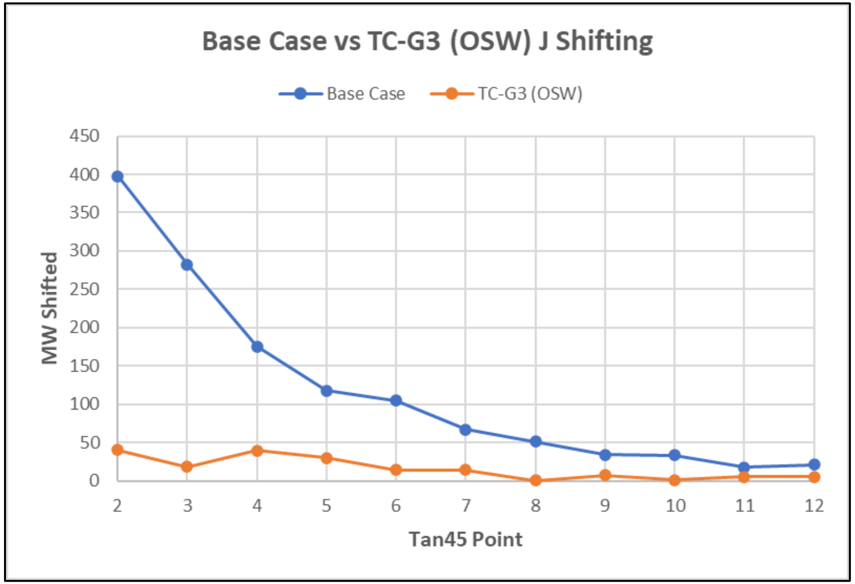
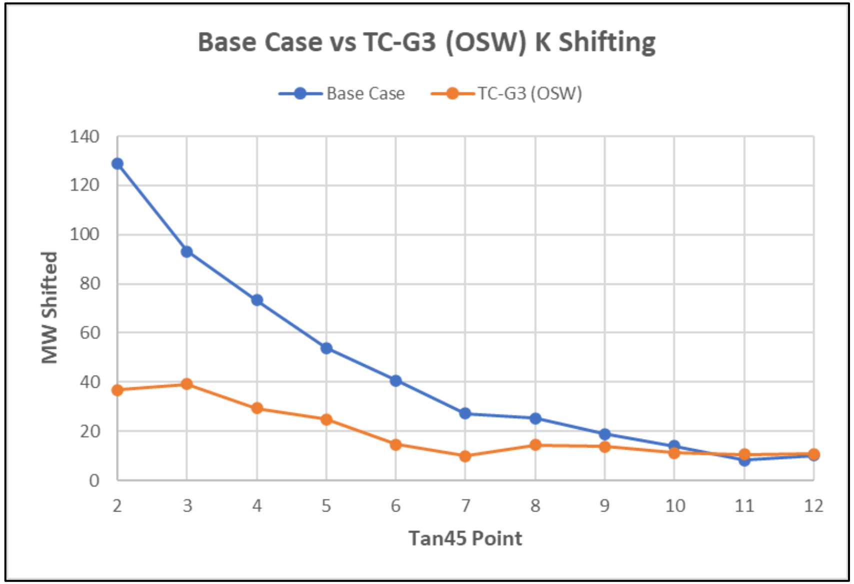
OSW Test Case (TC-G3) Shifting Comparison





- With the addition of significant amounts of capacity downstate, the curves begin to flatten as less capacity is required to be shifted out of Load Zone J or K when the IRM increases to maintain the same 0.1 LOLE

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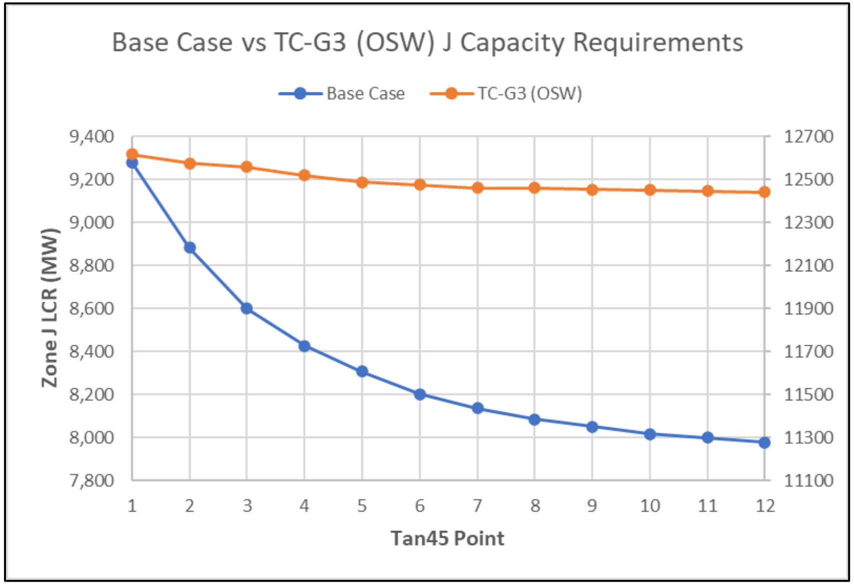
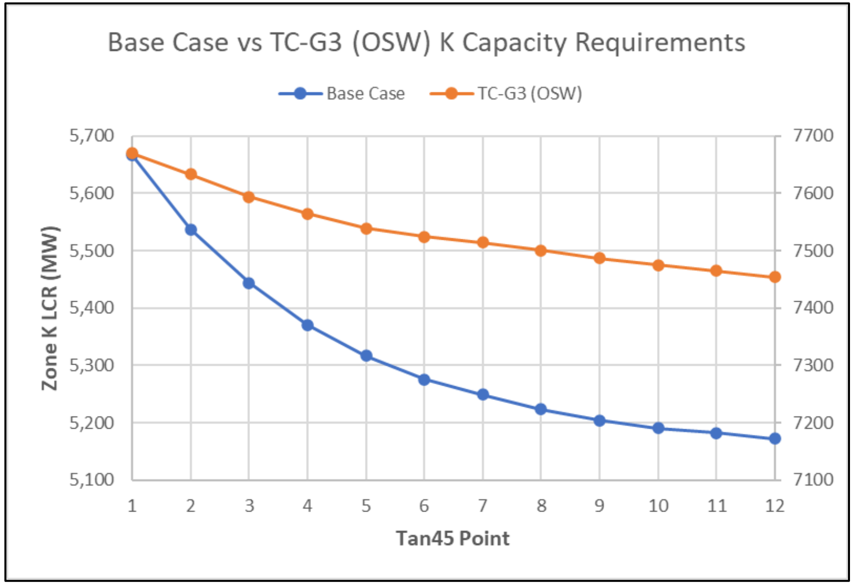
OSW Test Case (TC-G3) Capacity Requirement Comparison





- The comparison above highlights the flattening that occurs along the Tan45 curve
- In the TC-G3 (OSW) case, as the IRM increases by the 0.5% increments, substantially fewer MW are shifted from downstate to upstate to bring the system back to the 0.1 LOLE target

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Next Steps

Next Steps

- The NYISO will continue developing the remaining test cases outlined in the testing plan and anticipates bringing assumptions related to the modeling of the LI PPTN to the 7/30/2024 ICS meeting
- The scope for the 2025 phase 2 of this project will be developed with input from ICS by the end of 2024

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?

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

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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 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 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 accounts for the locational differences between upstate and downstate
  - 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 the 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

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Past Results

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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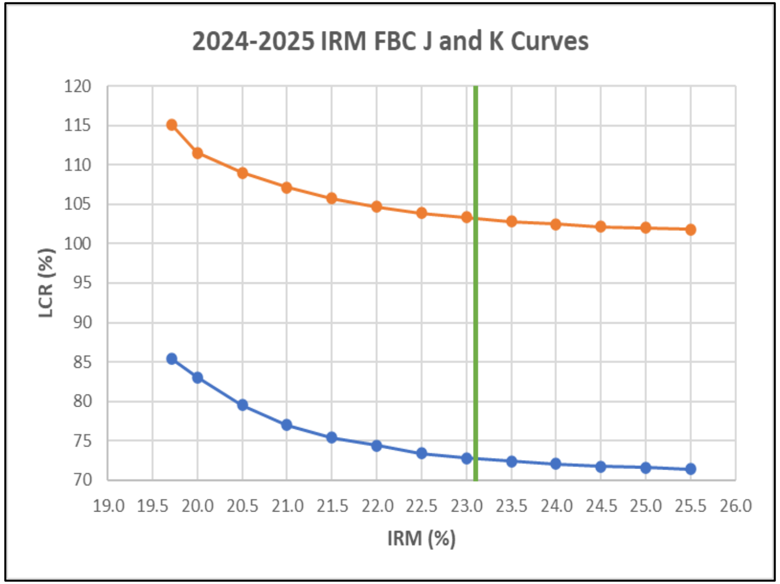
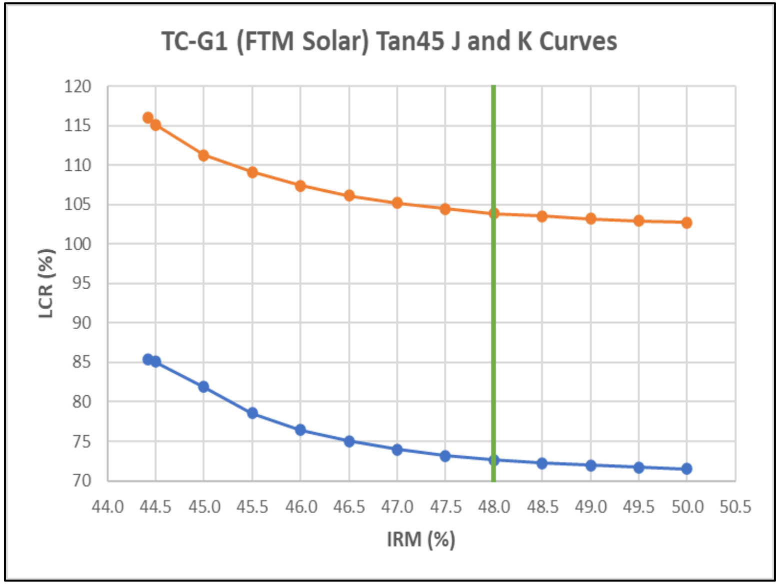
FTM Solar Tan45 Curve Comparison





- 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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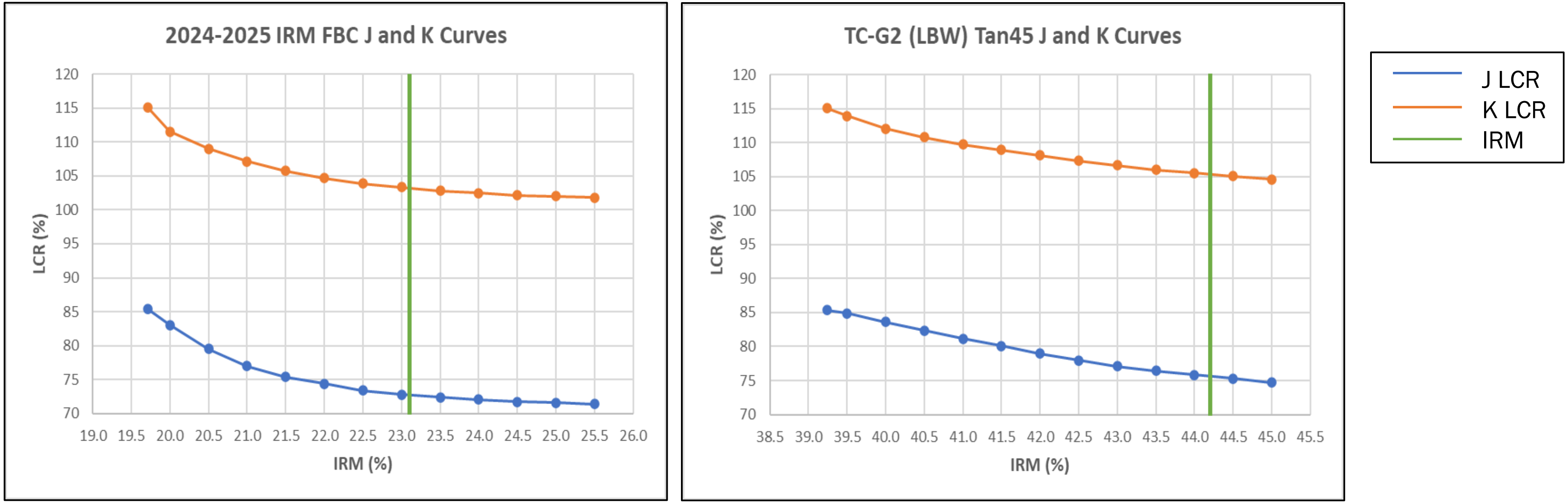
LBW Tan45 Curve Comparison



- 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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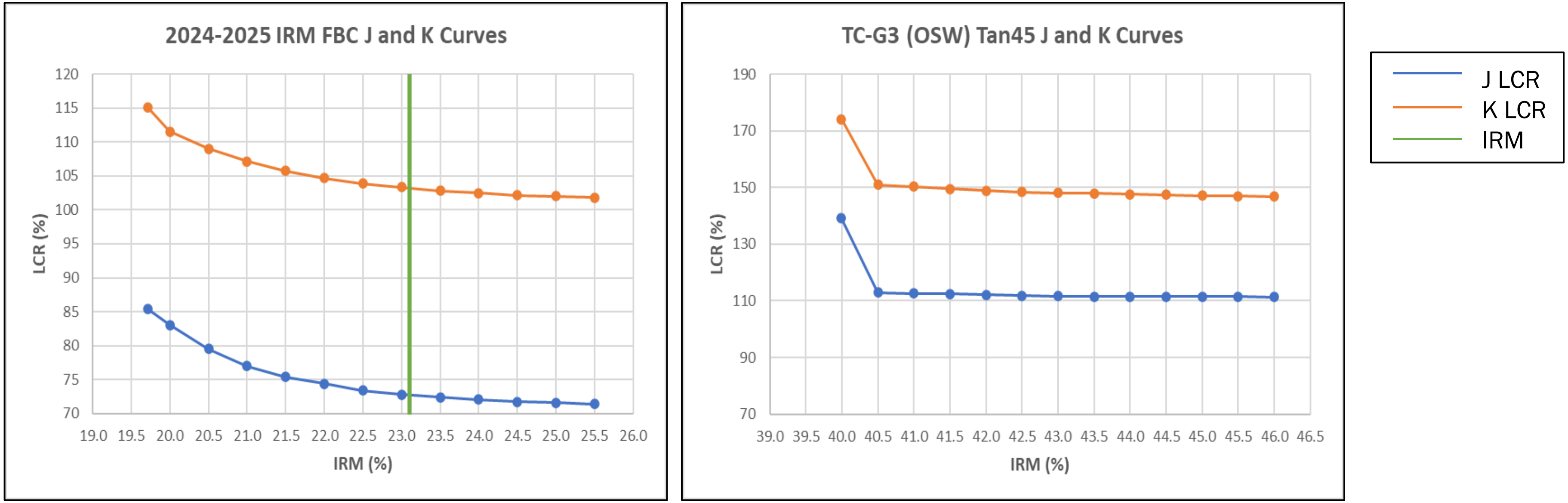
OSW Tan45 Curve Comparison



- 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

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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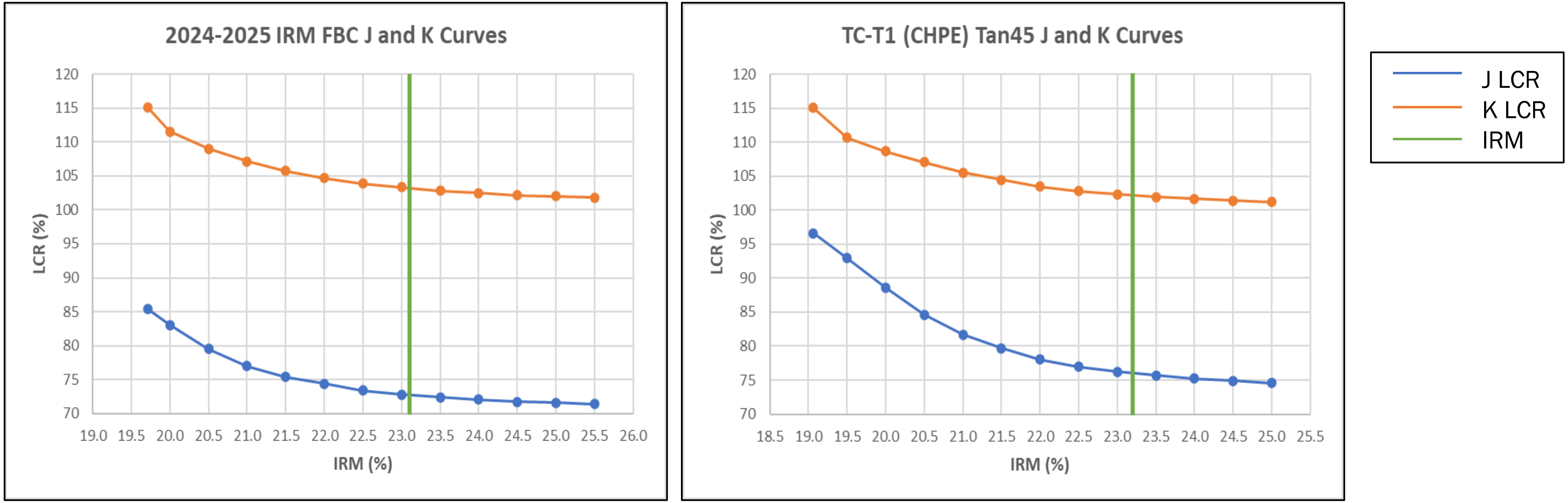
CHPE Tan45 Curve Comparison



- 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

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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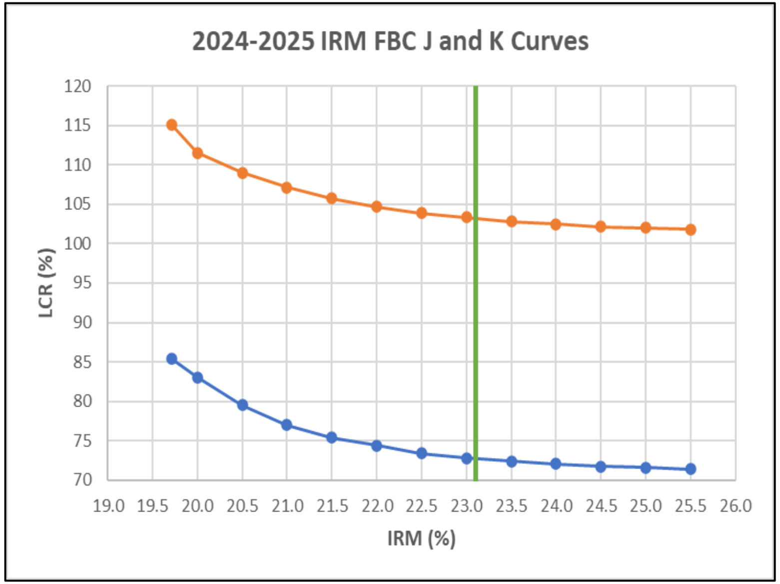
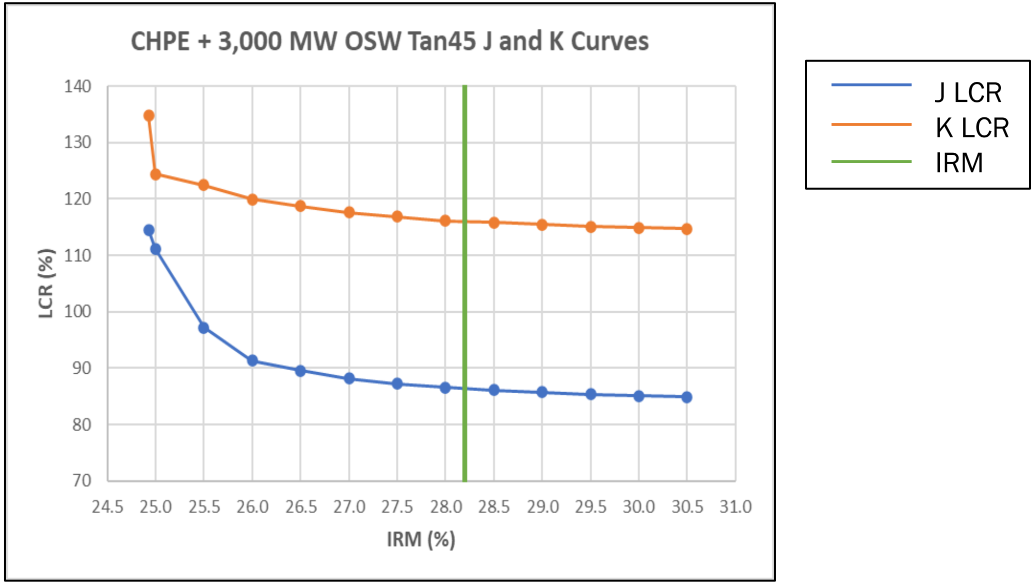
CHPE + 3,000 MW OSW Curve Comparison





- 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

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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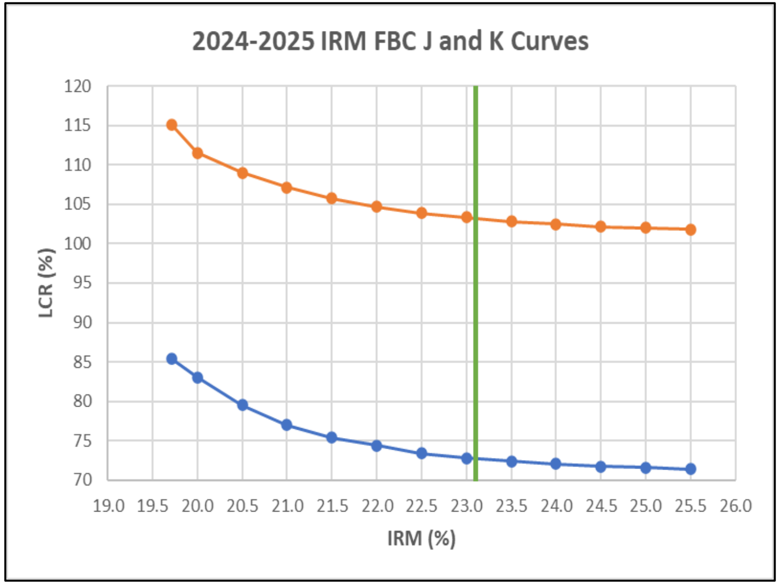
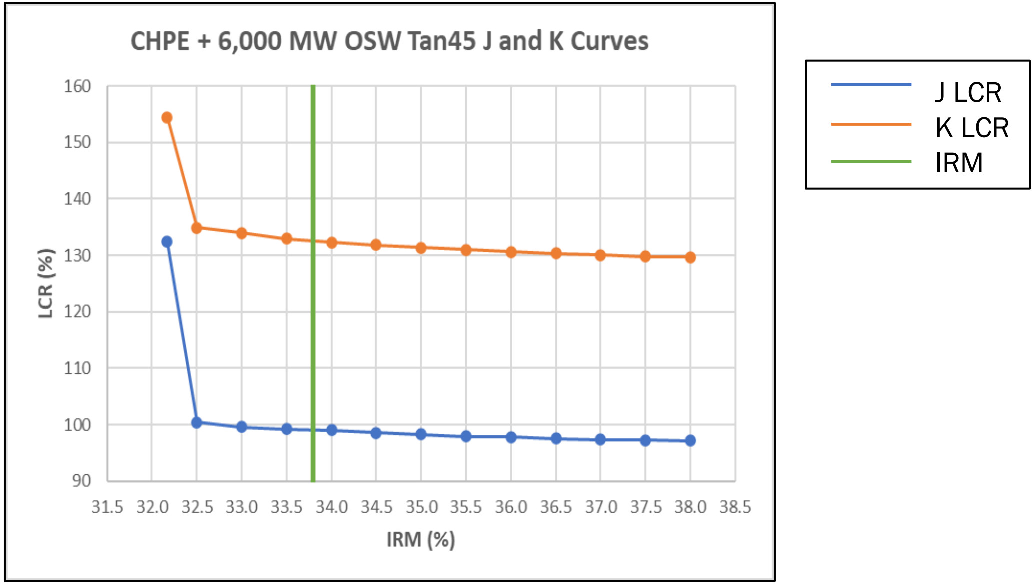
CHPE + 6,000 MW OSW Curve Comparison





- The curves are even steeper than the previous case (see Slide 10) 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) results reviewed at the 5/1/2024 ICS meeting 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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