New York ISO
Independent System Operator

Unified Methodology & IRM Anchoring Method

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Resource Adequacy

ICS Meeting 232

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Agenda

- The Purpose of this presentation is to explain the Tan45 Analysis performed by the NYISO Staff
- Topics covered include a Process Overview, Numerical Computation (MARS), and Final Results

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Unified Methodology

Unified Methodology- General

- All reserve margin calculations are performed in terms of ICAP
- All shifting and removing of MW is performed in terms of UCAP
- All GE MARS runs are performed until the 0.1 LOLE criterion is met
- UCAP excess = Zonal UCAP – Zonal Peak Load Forecast
  - Zonal ICAP = Zonal Generation Resources (excluding SCRs) + Imports - Exports
  - Zonal UCAP = Zonal ICAP * (1 – weighted average zonal outage rate of generation resources)
- All UCAP is translated back into ICAP based upon the zonal outage rate of the respective zone for calculation purposes
- Zonal outage rate is determined using the following elements:
  - Zonal generation resources (excluding SCRs)
  - Weighted average methodology is used

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Introduction and Summary

- **Purpose: To develop the IRM vs. LCRs curves**
  - Within the NYCA, there are two localities to which this procedure applies: NYC (Zone J) and Long Island (Zone K)
    - No shifting is performed in Zones G, H, or I (the Zones, with Zone J, that comprise the G-J Locality). As such, Zone G-I capacity is left at "as-found" levels throughout the Tan45 process
- **In this method:**
  - ICAP is removed from capacity rich Zones west of the Total-East interface until a study point IRM is reached
    - Eligible Zones are Zones A – E. Because Zone F is east of the Total-East interface, no shifting is performed on Zone F, and capacity is left at the "as-found" level throughout the Tan45 process.
    - This requirement has historically resulted in capacity being removed from Zones A, C, and D, shifted into Zones A, C, and D
  - At this point, capacity is shifted from Zones J and K into Zones A, C, and D until the 0.1 LOLE criterion is achieved
  - Doing this at various IRM points yields IRM vs. LCR curves

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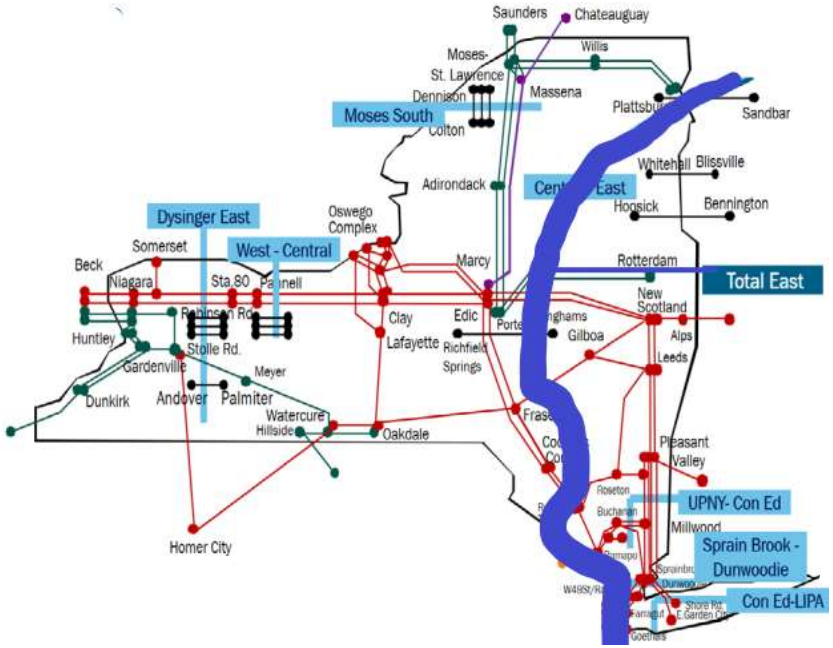
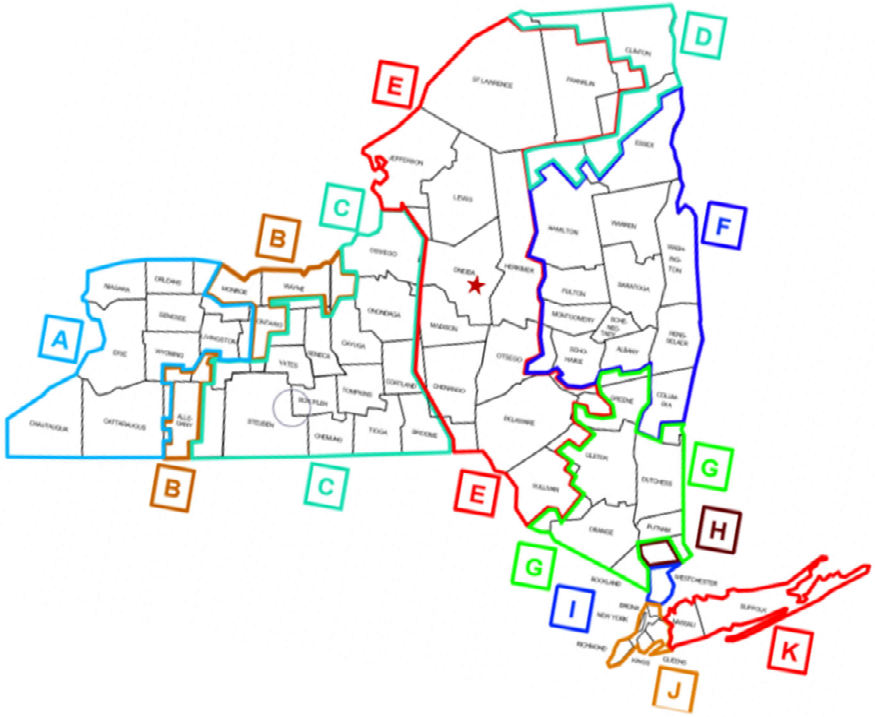
Interfaces



Zones



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Initial Conditions

- Any Multi-Area Reliability Simulation (MARS) database in the as-found condition with a desired set of study parameters and assumptions, including:
  - Load model
  - Capacity model
  - Transmission model
  - External Area World model
- For the purposes of the IRM study, this process is run (at a minimum) on the Preliminary and Final IRM base cases and a Special Sensitivity case (if one is needed)

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Determining the Low Point of the Tan 45 Curve

- ICAP is removed from the capacity rich Zones (A, C, and D) until the LOLE criterion is met
- ICAP is removed in proportion to the excess UCAP in the Zone as indicated in the sample calculation below (500 MW is being removed)
- The reserve margin determined is the low point of the Tan 45 curve

	Load Forecast	UCAP Capacity	Outage Rate	Excess UCAP	Per Unit Value	UCAP Removed	ICAP Removed
Zone X	1000	1500	0.0561	500	0.071	-35.676	-37.799
Zone Y	2000	2300	0.1149	300	0.502	-251.011	-283.611
Zone Z	500	700	0.3384	200	0.236	-118.155	-178.590
						-404.842	-500
ICAP MW Removed	-500						

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Tan 45 Curve Points

- Starting with the low point reserve margin, the MARS database is set to the next ten to twelve reserve margin values by removing capacity from Zones A, C, and D
- For each margin point capacity is shifted from the locality to Zones A, C, and D while keeping the other locality at the as-found condition until the LOLE criterion is met
- Upon completion, capacity is then shifted in the ratio of the individual locality capacity values for each margin point until the LOLE criterion is met

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Capacity Multiplier for the Localities

- Equal to the capacity shifted for each locality divided by the sum of the total capacity shifted for both localities
- Sample calculation for 300 MW and 100 MW shifted from the two localities

$$CM_1 = \frac{300\ MW}{300\ MW + 100\ MW}$$

$$CM_1 = .75$$

$$CM_2 = \frac{100\ MW}{300\ MW + 100\ MW}$$

$$CM_1 = .25$$

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The Indicative Minimum Locational Capacity Requirements (LCRs)

- For each margin point, the remaining amount of ICAP in each locality is divided by the forecast peak load for that locality to determine the indicative minimum LCR value for that point
- For each locality, a set of regression curves is calculated to fit a quadratic equation to each set of margin points
- The Tan 45 reserve margin point (-1 slope of the curve) is calculated for all possible combinations of at least four consecutive curve points
- The results are ranked by highest R^2 value and solutions that do not meet criteria are removed (described later)
- The average of the reserve margins at the Tan 45 point for each locality is the IRM value

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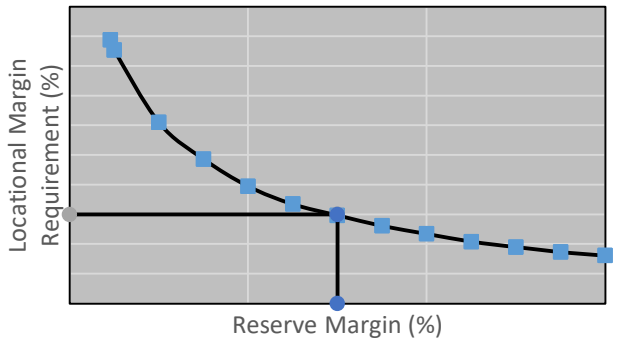
Anchoring Methodology

Tan 45 Example

- **The IRM/LCR characteristic consists of a curve function and straight line segments at the asymptotes**
  - Curve function is represented by a quadratic equation curve which is the basis for the Tan45 inflection point calculation



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Tan 45 Procedure Example

- Find low point on the curve by removing MW from Zones A, C, D until criteria is met (example 16.46%)
- Translate the UCAP into ICAP and calculate the reserve margin
- Increment Reserve Margin to next .5 increment (example 16.5%)
- Tan 45 curve consists of 10-12 reserve margin points (16.5% to 22%)
  - Shifting out of Zone J into Zones A, C, D
  - Shifting out of Zone K into Zones A, C, D
  - Shifting using ratio of J:K into A, C, and D

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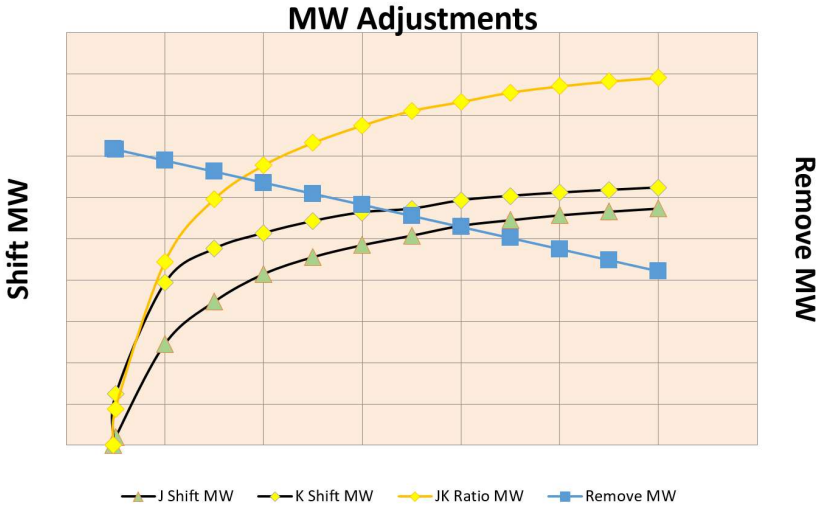
Tan 45 Procedure Example Cont'd

- Reset the database to the as-found condition and set the reserve margin to the first Tan 45 point
- Shift capacity from Zone J to Zones A, C, and D until criteria is met – repeat process for each Tan 45 point
- Shift capacity from Zone K to Zones A, C, and D until criteria is met – repeat process for each Tan 45 point
- Reset the database to the as-found condition and set the reserve margin to the first Tan 45 point
- Shift capacity from Zone J and Zone K for each Tan 45 point in the ratio of the ICAP MW determined from the individual shifting MARS runs above
- Graph to the right represents the ICAP MW values for all the MARS runs (@ 0.1 LOLE) of the Tan 45 curves



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Regression Analysis

- Start with all the points on the IRM/LCR Curve (except the curve low point)
- Develop regression curve equations for all possible reserve margin values consisting of at least four consecutive points.
- Create table with all possible combinations (for both the J and the K curves individually)
  - Remove any equations that show a negative coefficient in first term
  - Remove equations where the reserve margin is outside range of points
  - Remove equations where the reserve margin is within .5% of edge of point range taken
  - Rank by R^2 value – highest value is the reserve margin for the individual curve
  - Record polynomial equation for the above value
- Average the two reserve margin values to determine the IRM
- Use the IRM value with the polynomial equations for Zone J and Zone K from above analysis to determine the indicative J and K LCR values
- Run MARS with those values to determine that 0.1 LOLE criterion is met
- Round the IRM and J LCR and K LCR values to the nearest 0.1% and run that case to determine that criteria is still met - round further if LOLE criteria is not met
- This process is automated with Python Code
- Results validated by PSEG LI and Con Edison

RM	J LCR	K LCR
16.46	89.885	117.588
16.50	89.541	113.555
17.00	87.098	107.788
17.50	85.866	105.359
18.00	84.948	103.657
18.50	84.350	102.658
19.00	83.968	102.005
19.50	83.617	101.410
20.00	83.346	100.961
20.50	83.085	100.573
21.00	82.902	100.256
21.50	82.733	100.043
22.00	82.612	99.822

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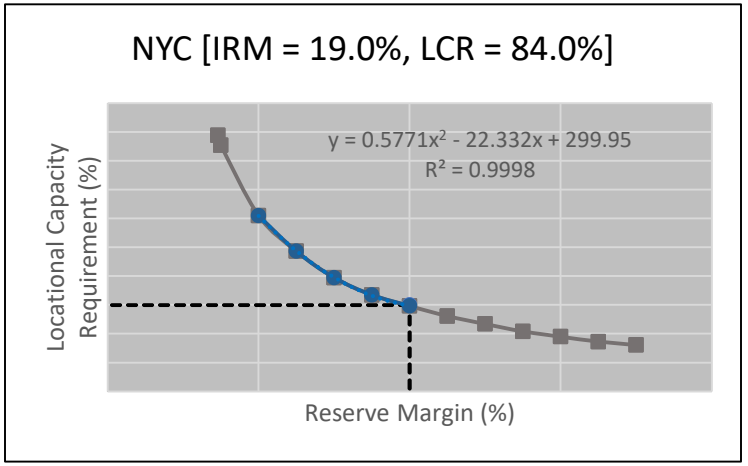
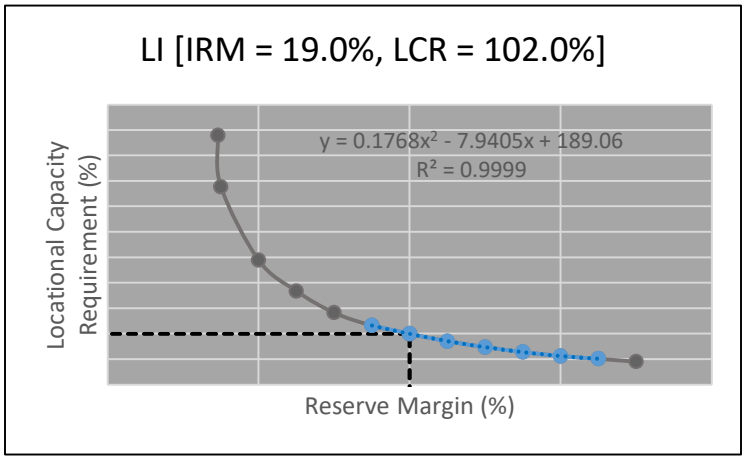
Results

- The validated results are summarized to establish the IRM and indicative LCR values for Zones J and K

Summary Results				
	IRM	**J LCR**	**K LCR**	**G-J**
	19.057	**83.959**	**101.931**	
J - IRM	18.481	84.343		
K - IRM	19.632		101.296	
	ax^2	**bx**	**c**	**LCR**
J LCR	0.577143	-22.332343	299.945314	**83.959**
K LCR	0.176762	-7.940476	189.057429	**101.931**





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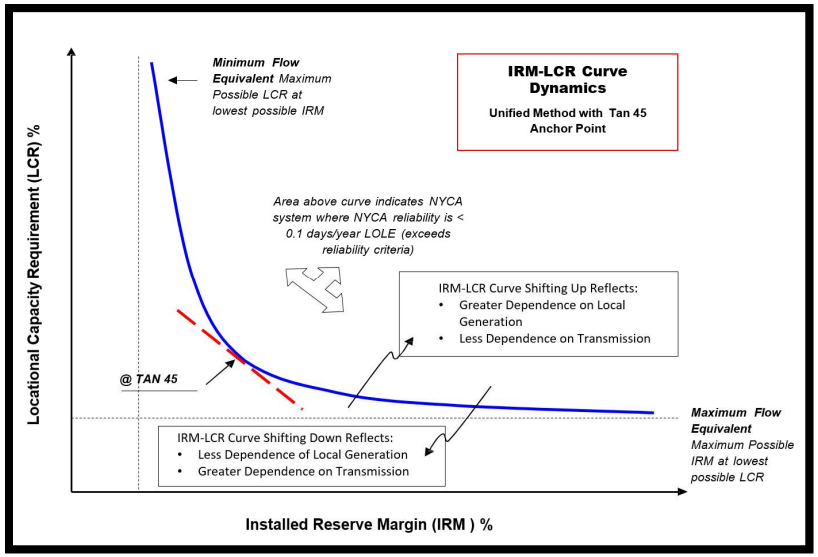
Summary

- Purpose: Identifies the NYCA IRM requirements and indicative MLCRs from curves established by the Unified Methodology
  - The curve is based on the study reserve margin points and the associated Locality reserve margins after the joint (simultaneous) Zone J and Zone K shifts occur
- The "Anchor Point" on the curve is selected by applying a tangent of 45 degrees analysis at the bend of the curve
- Extreme points on either side of the curve may create disproportionate changes in IRM and indicative LCRs
- A regression analysis is used to best fit the curves and determine the "Tan45" point



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Next Steps

- Receive feedback during 6/3 ICS meeting. Return to future meetings for further discussion on the Tan45 process if desired.
- Identify potential changes in the Tan45 method that could impact the value of renewables as identified in the NYSRC High Renewable Whitepaper
  - Potential examples include:
    - The inclusion of SCRs in ICAP, UCAP, and zonal outage rate calculations that determine shifting
    - Capacity shift into Zones A – F (revisit the "west of Total East" and "excess capacity" requirements of Policy 5) with respect to the flattening of the curve over the years
    - Should capacity be shifted out of Zones G, H, and I during the Tan45 process
    - Are results stable if the current LCR optimizer method is used to establish the IRM
    - Additional new methods to remove or shift MWs
- Evaluate method changes prioritized by the NYSRC vis-à-vis the High Renewables Case
- Evaluate how changes in the Tan45 method compare with current Tan45 outcomes, *e.g.,* 2020 Final Base Case

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- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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Questions?