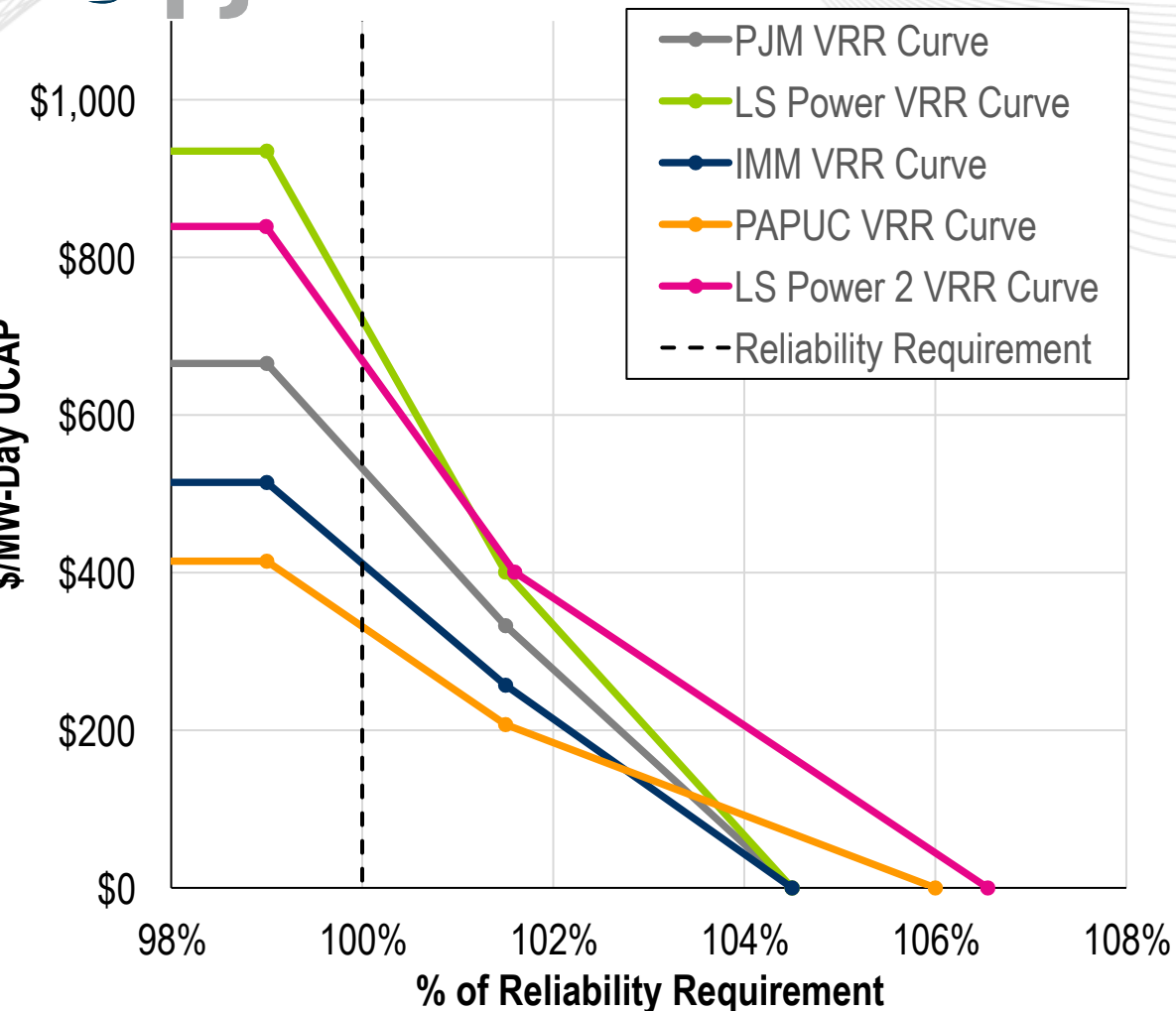


VRR Analysis Comparison

Market Implementation Committee
August 22, 2025

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Lead Market Design Specialist
Market Design

- These slides group relevant analysis Brattle has conducted for the long term VRR analysis for different VRR curve shapes throughout the Quadrennial Review process
- The accompanying VRR analysis may not exactly match the proposed price quantity values used by the package owner, but the VRR analysis for each curve is a good approximation for expected performance
- Additional details for the calculation of the VRR analysis can be found in the [April VRR Report and appendix](#)



Initial – RTO VRR Curve Comparison

All proposed VRR curves maintain the 3-point VRR Curve design

PJM: (Using Brattle Calculated CONE values for CC)

Point 1: 99%, $\text{Max}(1.75 \times \text{Net CONE}, 0.6 \times \text{Gross CONE})$

Point 2: 101.5%, $0.5 \times \text{Price Cap}$

Point 3: 104.5%, \$0

LS Power: (Using Brattle Calculated CONE values for CT)

Point 1: 99%, $\text{Max}(1.75 \times \text{Net CONE}, 1.0 \times \text{Gross CONE})$

Point 2: 101.5%, $0.75 \times \text{Net CONE}$

Point 3: 104.5%, \$0

IMM: (Using IMM Calculated CONE values for CT)

Point 1: 99%, $\text{Min}(1.5 \times \text{Net CONE}, 1.0 \times \text{Gross CONE})$

Point 2: 101.5%, $0.5 \times \text{Price Cap}$

Point 3: 104.5%, \$0

(VC Barrow) PA PUC: (Using IMM Calculated CONE values for CC)

Point 1: 99%, $1.15 \times \text{Gross CONE} - 0.75 \times \text{Net EAS}$

Point 2: 101.5%, $0.5 \times \text{Price Cap}$

Point 3: 106.0%, \$0

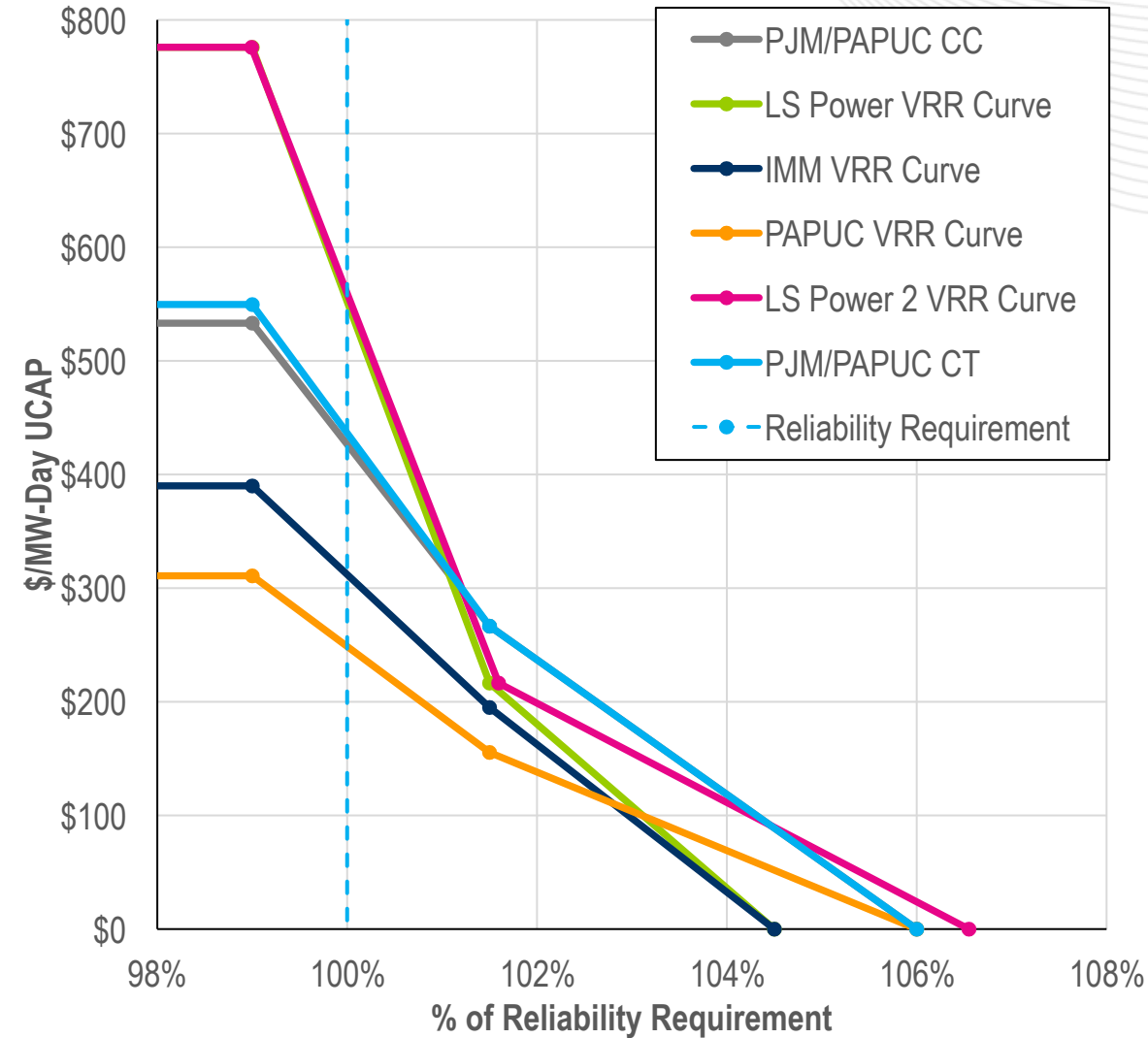
LS Power 2: (Using Brattle Calculated CONE values for CT)

Point 1: $(100\% + \text{IRM} - 1.2\%) / (100\% + \text{IRM})$, $\text{Max}(1.5 \times \text{Net CONE}, 1.0 \times \text{Gross CONE})$

Point 2: $(100\% + \text{IRM} + 1.9\%) / (100\% + \text{IRM})$, $0.75 \times \text{Net CONE}$

Point 3: $(100\% + \text{IRM} + 7.8\%) / (100\% + \text{IRM})$, \$0

Updated 8/25 – RTO VRR Curve Comparison



All proposed VRR curves maintain the 3-point VRR Curve design

PJM/(VC Barrow) PA PUC CC: (Using Brattle Calculated CONE values for CC)

Point 1: 99%, 1.15 x Gross CONE – 0.75 x Net EAS

Point 2: 101.5%, 0.5 x Price Cap

Point 3: 106.0%, \$0

LS Power: (Using Brattle Calculated CONE values for CT)

Point 1: 99%, Max(1.75 x Net CONE, 1.0 x Gross CONE)

Point 2: 101.5%, 0.75 x Net CONE

Point 3: 104.5%, \$0

IMM: (Using IMM Calculated CONE values for CT)

Point 1: 99%, Min(1.5 x Net CONE, 1.0 x Gross CONE)

Point 2: 101.5%, 0.5 x Price Cap

Point 3: 104.5%, \$0

(VC Barrow) PA PUC: (Using IMM Calculated CONE values for CC)

Point 1: 99%, 1.15 x Gross CONE – 0.75 x Net EAS

Point 2: 101.5%, 0.5 x Price Cap

Point 3: 106.0%, \$0

LS Power 2: (Using Brattle Calculated CONE values for CT)

Point 1: $(100\% + \text{IRM} - 1.2\%) / (100\% + \text{IRM})$, Max(1.5 x Net CONE, 1.0 x Gross CONE)

Point 2: $(100\% + \text{IRM} + 1.9\%) / (100\% + \text{IRM})$, 0.75 x Net CONE

Point 3: $(100\% + \text{IRM} + 7.8\%) / (100\% + \text{IRM})$, \$0

PJM/(VC Barrow) PA PUC 2 CT: (Using Brattle Calculated CONE values for CT)

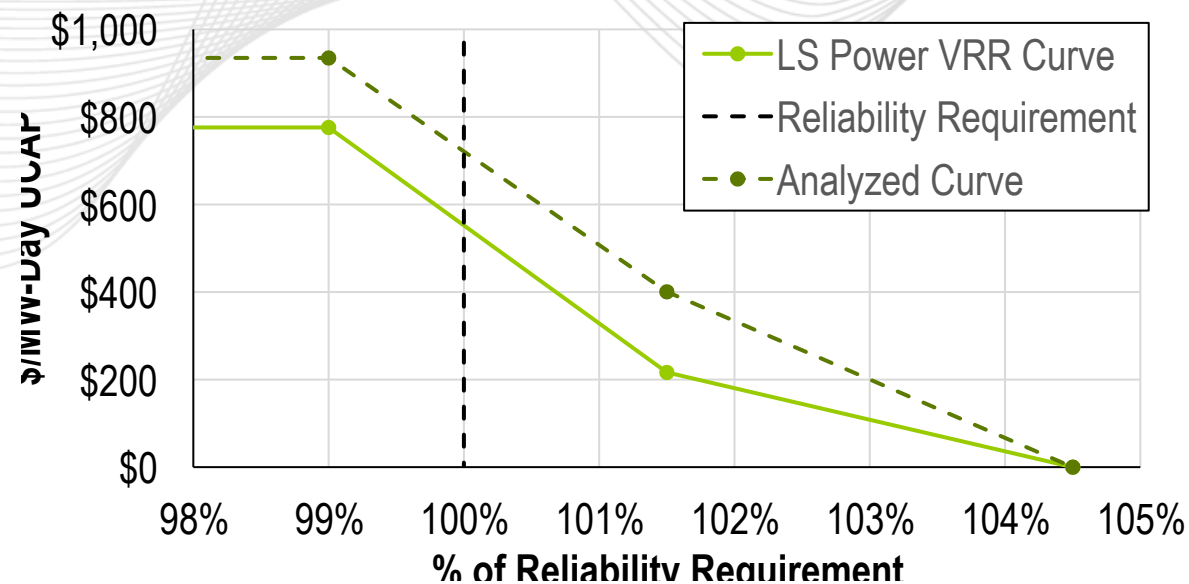
Point 1: 99%, 1.15 x Gross CONE – 0.75 x Net EAS

Point 2: 101.5%, 0.5 x Price Cap

Point 3: 106.0%, \$0

VRR Analysis: Status Quo/LS Power

	Status Quo/LS Power	
	MW	Price
Point 1	99.0%	Max(1.75 x Net CONE, Gross CONE)
Point 2	101.5%	0.75 x Net CONE
Point 3	104.5%	\$0



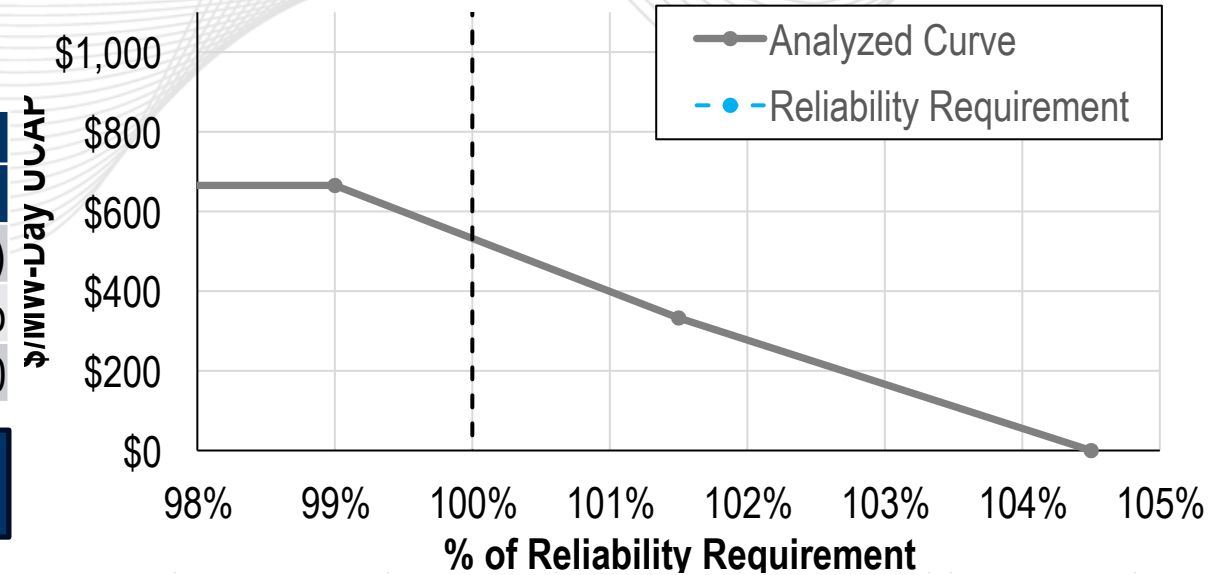
	Price			Reliability						Cost
	Average Clearing Price	Standard Deviation	Frequency at Cap	Average LOLE	Average Excess (Deficit) Above Reliability Requirement	Average Excess (Deficit) Above Target Reserve Margin	Normalized Portfolio EUE (% of Target)	Frequency Below Reliability Requirement	Frequency Below 99% of Reliability Requirement	Average Procurement Cost
	(\$/MW-d)	(\$/MW-d)	(%)	(events/yr)	(MW)	(UCAP RR + X %)	(%)	(%)	(%)	(\$ mln/yr)
Current Curve: CT-based Net CONE @ \$528, Price Cap @ \$924										
\$328 Overest. (True Ref Price = \$200)	\$200	\$98	0.1%	0.033	3,983	2.81%	34.1%	0.1%	0.1%	\$10,101
\$178 Overest. (True Ref Price = \$350)	\$350	\$183	2.3%	0.053	2,607	1.86%	54.9%	6.3%	2.3%	\$17,491
\$128 Overest. (True Ref Price = \$400)	\$400	\$204	4.4%	0.062	2,159	1.54%	64.9%	10.4%	4.5%	\$19,912
\$78 Overest. (True Ref Price = \$450)	\$450	\$220	7.3%	0.072	1,713	1.23%	76.9%	15.2%	7.3%	\$22,310
\$28 Overest. (True Ref Price = \$500)	\$500	\$231	10.4%	0.084	1,264	0.92%	91.4%	21.3%	10.6%	\$24,690
\$23 Underest. (True Ref Price = \$550)	\$550	\$236	15.3%	0.098	793	0.59%	109.4%	28.9%	15.3%	\$27,046

<https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250411-special/item-1-03-sixth-review-of-pjm-vrr-curve.pdf>

VRR Analysis: June PJM Proposal

	PJM Proposal	
	MW	Price
Point 1	99.0%	Max(1.75 x Net CONE, 0.6 x Gross CONE)
Point 2	101.5%	0.5 x Price Cap
Point 3	104.5%	\$0

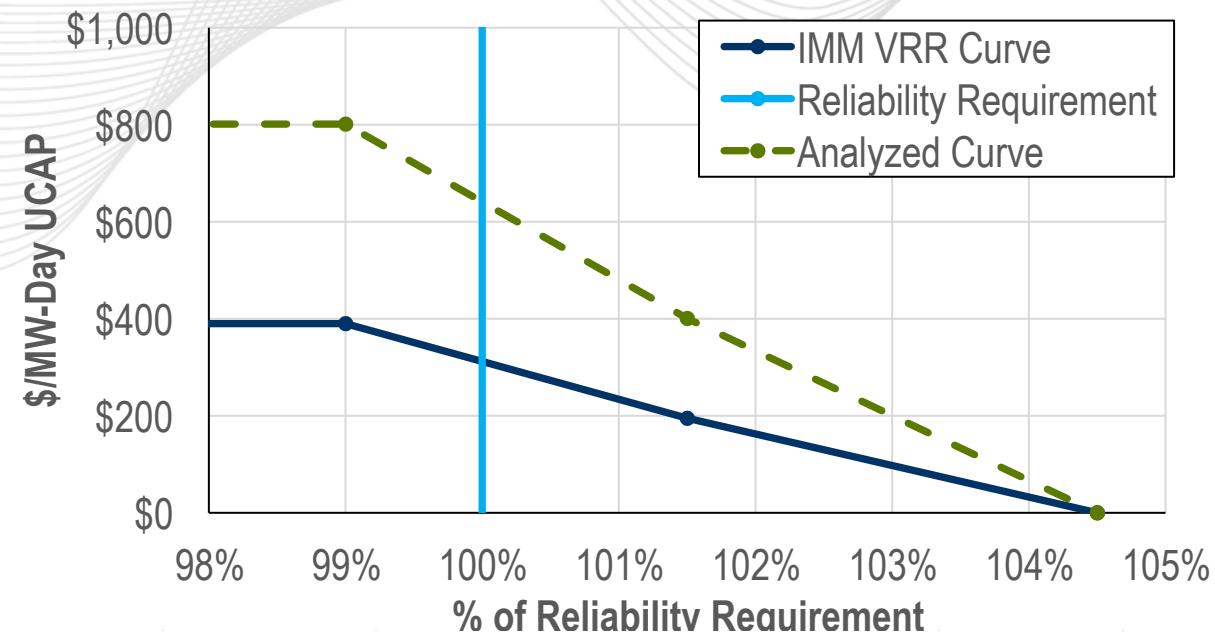
Not currently included in a package



	Price			Reliability						Cost
	Average Clearing Price	Standard Deviation	Frequency at Cap	Average LOLE	Average Excess (Deficit) Above Reliability Requirement	Average Excess (Deficit) Above Target Reserve Margin	Normalized Portfolio EUE (% of Target)	Frequency Below Reliability Requirement	Frequency Below 99% of Reliability Requirement	Average Procurement Cost
	(\$/MW-d)	(\$/MW-d)	(%)	(events/yr)	(MW)	(UCAP RR + X %)	(%)	(%)	(%)	(\$ mln/yr)
Net CONE Overestimated	\$228	\$103	0.5%	0.044	3,003	2.13%	45.9%	1.9%	0.5%	\$11,424
Net CONE Correctly Estimated	\$380	\$155	9.5%	0.084	1,158	0.84%	89.8%	21.4%	9.5%	\$18,757
Net CONE Underestimated	\$532	\$143	37.7%	0.173	(1,153)	-0.77%	212.9%	58.7%	37.7%	\$25,745

<https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250616-special/20250616-pjm-quad-review-proposal.pdf>

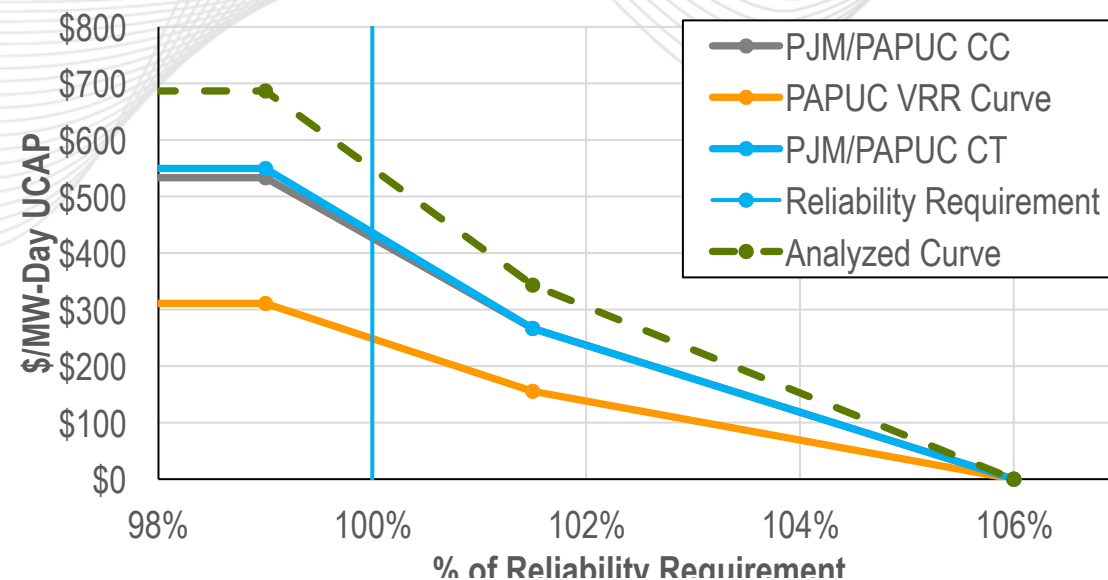
	IMM	
	MW	Price
Point 1	99.0%	Min(1.5 x Net CONE, 1.0 x Gross CONE)
Point 2	101.5%	0.5 x Price Cap
Point 3	104.5%	\$0



	Price			Reliability						Cost
	Average Clearing Price	Standard Deviation	Frequency at Cap	Average LOLE	Average Excess (Deficit) Above Reliability Requirement	Average Excess (Deficit) Above Target Reserve Margin	Normalized Portfolio EUE (% of Target)	Frequency Below Reliability Requirement	Frequency Below 99% of Reliability Requirement	Average Procurement Cost
	(\$/MW-d)	(\$/MW-d)	(%)	(events/yr)	(MW)	(UCAP RR + X %)	(%)	(%)	(%)	(\$ mln/yr)
Net CONE Overestimated	\$320	\$155	2.0%	0.049	2,817	2.00%	51.1%	5.0%	2.0%	\$16,034
Net CONE Correctly Estimated	\$534	\$195	18.3%	0.108	498	0.39%	122.5%	33.4%	18.3%	\$26,188
Net CONE Underestimated	\$748	\$107	70.7%	0.344	(3,673)	-2.53%	485.8%	85.1%	70.7%	\$35,454

VRR Analysis: (VC Barrow) PA PUC & PJM/PA PUC

	(VC Barrow) PA PUC	
	MW	Price
Point 1	99.0%	1.15 x Gross CONE – 0.75 x Net EAS
Point 2	101.5%	0.5 x Price Cap
Point 3	106.0%	\$0

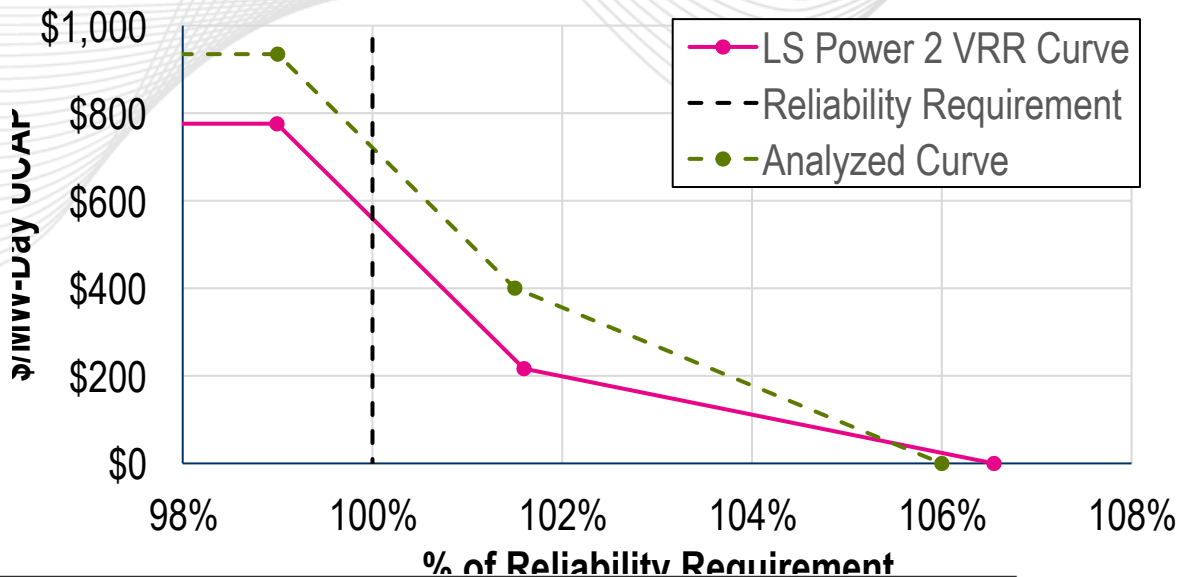


	Price			Reliability						Cost
	Average Clearing Price	Standard Deviation	Frequency at Cap	Average LOLE	Average Excess (Deficit) Above Reliability Requirement	Average Excess (Deficit) Above Target Reserve Margin	Normalized Portfolio EUE (% of Target)	Frequency Below Reliability Requirement	Frequency Below 99% of Reliability Requirement	Average Procurement Cost
	(\$/MW-d)	(\$/MW-d)	(%)	(events/yr)	(MW)	(UCAP RR + X %)	(%)	(%)	(%)	(\$ mln/yr)
Net CONE Overestimated	\$228	\$94	0.1%	0.034	4,093	2.90%	34.9%	1.0%	0.1%	\$11,504
Net CONE Correctly Estimated	\$380	\$150	6.7%	0.070	1,844	1.33%	74.8%	16.4%	6.7%	\$18,843
Net CONE Underestimated	\$532	\$151	30.8%	0.146	(514)	-0.32%	175.1%	49.9%	30.8%	\$25,869

<https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250709/20250709-informational-only---additional-modeling-results-for-papuc-vrr-curve.pdf>

VRR Analysis: LS Power 2

LS Power 2		
	MW	Price
Point 1	$(100\% + \text{IRM} 1.2\%) / (100\% + \text{IRM})$	$\text{Max}(1.5 \times \text{Net CONE}, 1.0 \times \text{Gross CONE})$
Point 2	$(100\% + \text{IRM} 1.9\%) / (100\% + \text{IRM})$	$0.75 \times \text{Net CONE}$
Point 3	$(100\% + \text{IRM} 7.8\%) / (100\% + \text{IRM})$	\$0



	Price			Reliability						Cost
	Average Clearing Price	Standard Deviation	Frequency at Cap	Average LOLE	Average Excess (Deficit) Above Reliability Requirement	Average Excess (Deficit) Above Target Reserve Margin	Normalized Portfolio EUE (% of Target)	Frequency Below Reliability Requirement	Frequency Below 99% of Reliability Requirement	Average Procurement Cost
	(\$/MW-d)	(\$/MW-d)	(%)	(events/yr)	(MW)	(UCAP RR + X %)	(%)	(%)	(%)	(\$ mln/yr)
Curve #2: Straight-line "wide" curve										
\$334 Overest. (True Ref Price = \$200)	\$200	\$88	0.1%	0.025	5,003	3.53%	26.4%	0.1%	0.1%	\$10,162
\$184 Overest. (True Ref Price = \$350)*	\$350	\$170	2.1%	0.047	3,110	2.21%	49.0%	5.2%	2.1%	\$17,536
\$134 Overest. (True Ref Price = \$400)	\$400	\$194	3.8%	0.057	2,554	1.82%	59.5%	9.2%	3.9%	\$19,951
\$84 Overest. (True Ref Price = \$450)	\$450	\$212	5.9%	0.067	2,023	1.45%	71.9%	13.7%	6.1%	\$22,346
\$34 Overest. (True Ref Price = \$500)**	\$500	\$225	9.7%	0.080	1,507	1.09%	86.7%	19.5%	9.9%	\$24,721
\$16 Underest. (True Ref Price = \$550)**	\$550	\$234	14.3%	0.094	997	0.74%	104.5%	26.5%	14.6%	\$27,077

<https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250519-special/informational-only---brattle-additional-modeling-results.pdf>

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SME/Presenter:

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VRR Analysis Comparison



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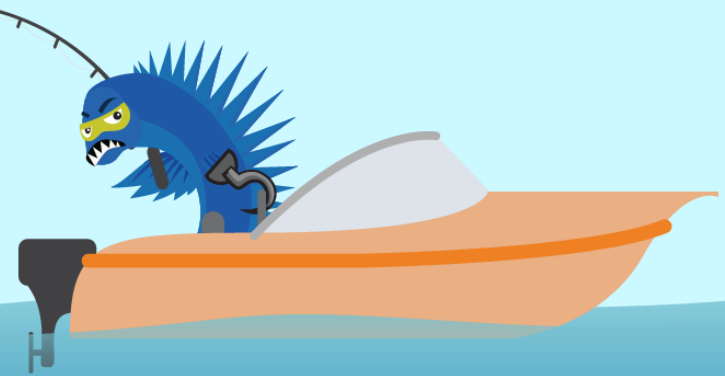
custsvc@pjm.com

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VRR Curve Report	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250411-special/item-1-03-sixth-review-of-pjm-vrr-curve.pdf
PJM Proposal	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250616-special/20250616-pjm-quad-review-proposal.pdf
Additional CT and CC modeling	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250616-special/additional-ct-and-cc-modeling-from-brattle-.pdf
Additional Modeling Results for PA PUC	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250709/20250709-informational-only---additional-modeling-results-for-papuc-vrr-curve.pdf
Additional Modeling Results	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250519-special/informational-only---brattle-additional-modeling-results.pdf
Quadrennial Review Update	https://www.pjm.com/-/media/DotCom/committees-groups/committees/mic/2025/20250806/20250806-item-05-1---quadrennial-review-update.pdf