



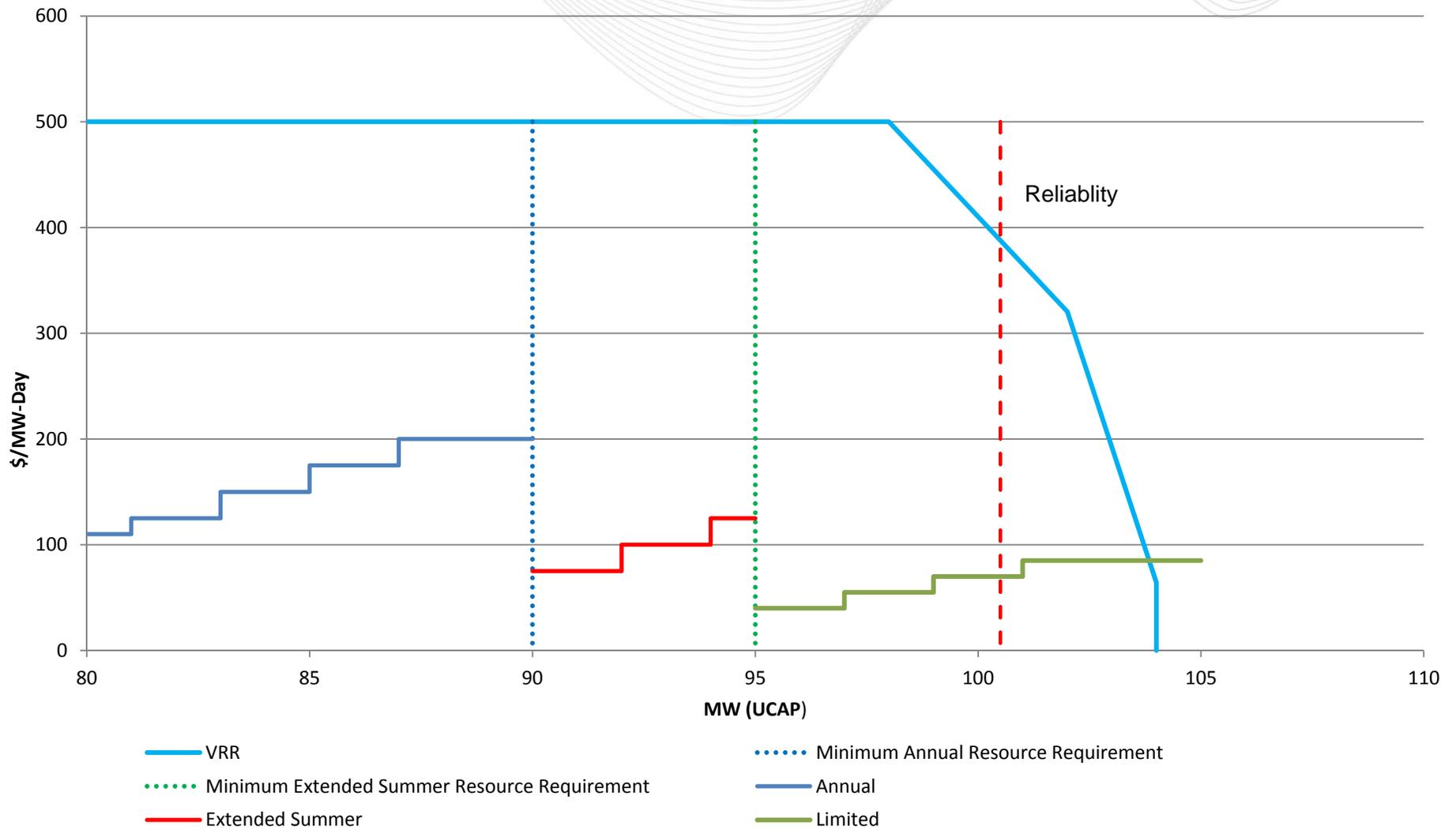
Clearing Limited DR in RPM Auctions

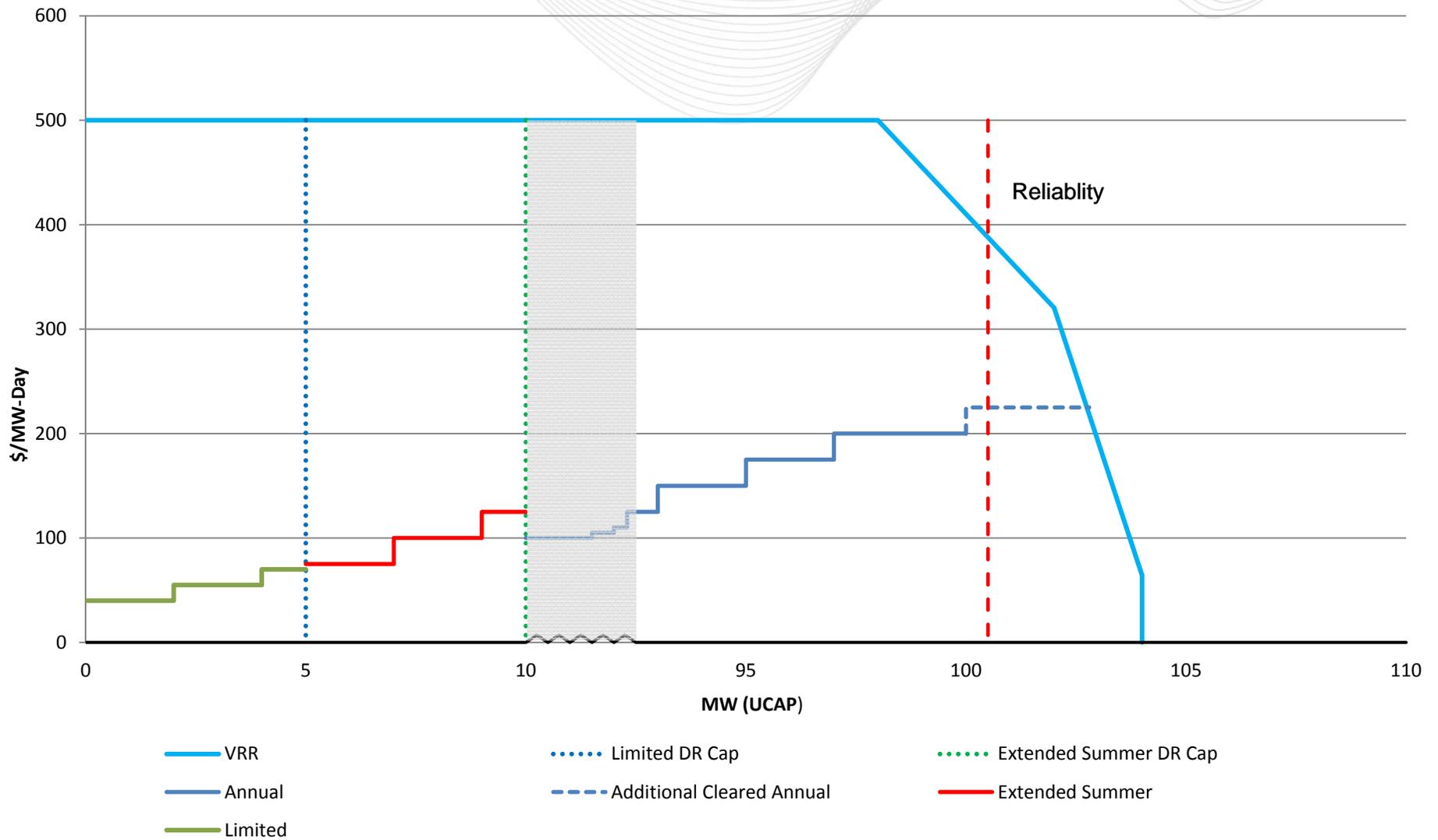
October 4, 2013

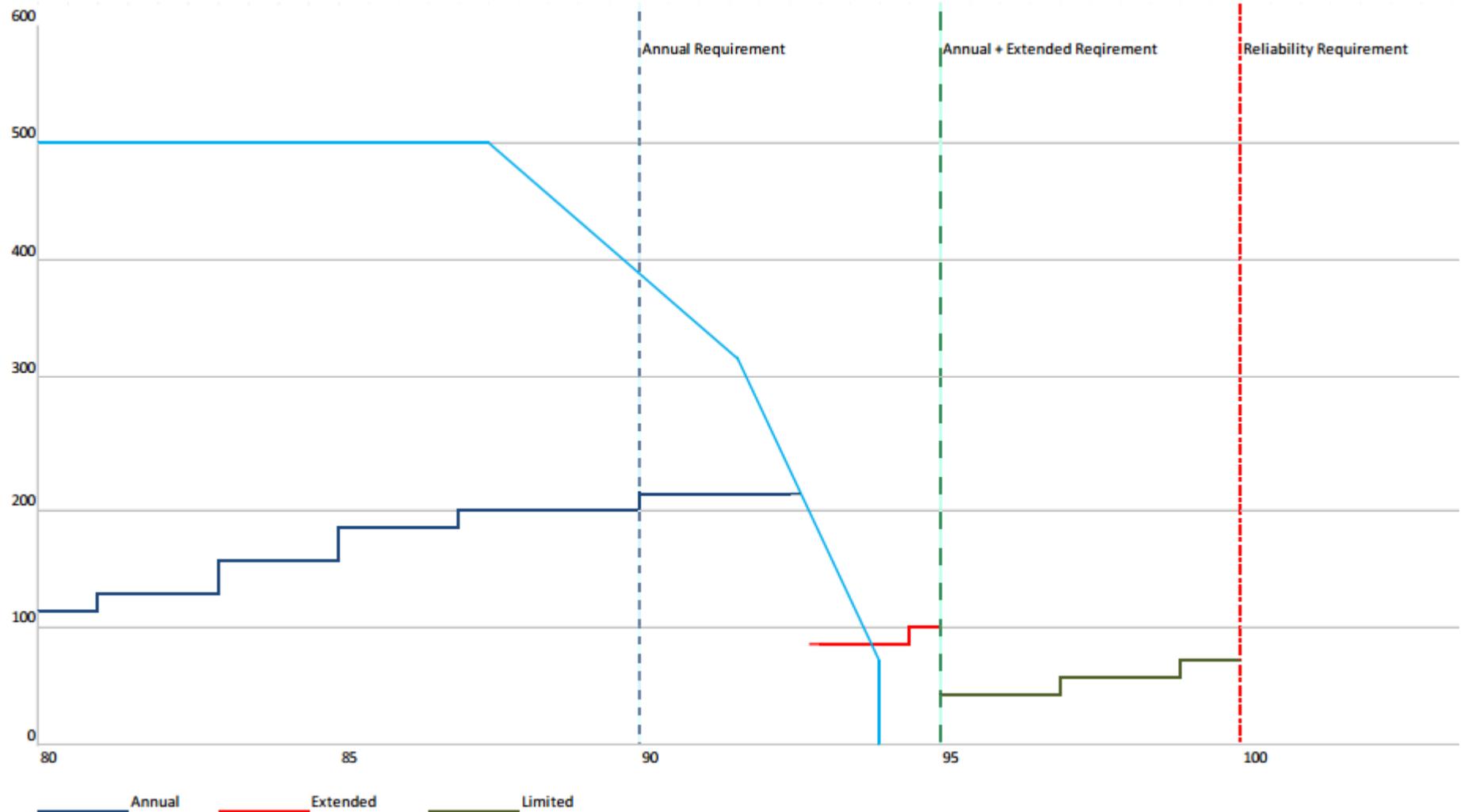
- Simulated BRA Results for alternate proposals brought forward to date
 - PJM proposal
 - Alternative proposal
- Education on clearing of coupled DR offers

- Status Quo: clear all product types against VRR curve(s) in least-cost manner subject to Minimum Annual and Minimum ES Resource Requirements
- PJM Proposal: clear all product types against VRR curve(s) in least-cost manner subject to Maximum Limited DR and Maximum ES DR constraints
- Alternative Proposal: clear annual resources against annual VRR curve(s)* in least-cost manner; then clear additional resources until total procured capacity for each LDA and the RTO equals the LDA/RTO Reliability Requirement

* Annual VRR Curve(s) is created by shifting original VRR Curve(s) to left by ES DR Reliability Target quantity









Simulation of Alternative Clearing Proposals

- 2015/16 and 2016/17 BRAs have been rerun using the alternative clearing proposals discussed on prior slide
- The Alternative Proposal cannot be solved in a single simultaneous optimization; therefore PJM has employed a two-pass approach in attempt to approximate the objectives and impacts of the proposal*
 - **1st Pass: Clear annual resources against annual RTO/LDA VRR curves**
 - Optimization determines new Minimum Requirement for Annual Resources based on sloped Annual VRR Curve
 - Subtracting the new Minimum Annual Requirement from the RTO/LDA Reliability Requirement determines the updated Maximum Limits for ES and Limited DR to be used in the 2nd Pass
 - **2nd Pass: Clear all resources against vertical demand curve equal to RTO/LDA Reliability Requirement subject to updated Maximum Limits from 1st Pass**
 - Simultaneously determines the least cost solution for exactly meeting the RTO/LDA Reliability Requirement subject to updated Maximum Limits for ES and Limited DR.

* Other assumptions have been made at various decision points in order to accomplish simulations; business rules need to be developed to address these decision points if proposal is to be further developed
(assumptions discussed after presentation of results)



2016/17 BRA Simulation Results of Alternative Clearing Proposals

2016/17 Planning Parameters	RTO
Reliability Requirement	161,974
Min Ext Summer Resource Requirement	158,512
Min Annual Resource Requirement	149,469
Max Limited DR Constraint	3,462
Max ES DR Constraint	12,505

Cleared Quantities	2016/17 BRA	PJM Proposal	Alt. Proposal
Cleared Annual MW	156,840	157,452	156,651
Cleared Ext Summer MW	2,470	7,831	2,103
Cleared Limited MW	9,850	3,462	3,221
Total Cleared MW	169,160	168,745	161,974
Total Cleared Annual + ES MW	159,310	165,283	158,754
Total Cleared Limited + ES MW	12,320	11,294	5,323
Clearing Prices			
RCP (Annual)	\$59.37	\$85.15	\$64.41
RCP (Extended Summer)	\$59.37	\$85.15	\$10.96
RCP (Limited)	\$59.37	\$16.44	\$10.96



2015/16 BRA Simulation Results of Alternative Clearing Proposals

2015/16 Planning Parameters	RTO
Reliability Requirement	158,708.0
Min Ext Summer Resource Requirement	155,316
Min Annual Resource Requirement	146,455
Max Limited DR Constraint	3,392
Max ES DR Constraint	12,253

Cleared Quantities	2015/16 BRA	PJM Proposal	Alt. Proposal
Cleared Annual MW	150,112	151,719	152,389
Cleared Ext Summer MW	5,202	8,859	2,927
Cleared Limited MW	9,247	3,392	3,392
Total Cleared MW	164,561	163,971	158,708
Total Cleared Annual + ES MW	155,314	160,578	155,316
Total Cleared Limited + ES MW	14,450	12,252	6,320
Clearing Prices			
RCP (Annual)	\$136.00	\$145.50	\$115.00
RCP (Extended Summer)	\$136.00	\$145.50	\$84.72
RCP (Limited)	\$118.54	\$54.00	\$43.62



Assumptions used in simulation of Alternative Proposal

- Cannot solve simultaneously, therefore the two-pass approach described on prior slide was used.
- Two assumptions can be made on the clearing of coupled annual resources considering the two-pass approach.
 - In the 1st pass solution, only annual resources are cleared against adjusted VRR curve(s); if coupled annual DR sell offers are allowed to clear in 1st pass then they will clear based solely on the sell offer price of the annual offer and independent of offer prices of their more limited coupled offers; i.e. results may not yield, most-economically favorable solution for seller as they do under current implementation
 - In the 1st pass solution, do not allow coupled annual sell offers to clear, but allow them to clear in 2nd pass. This preserves economics of coupled offers in 2nd pass, but can change the shape of the annual supply curve by introducing new annual resources that the 1st pass did not see and that may have otherwise cleared.

In simulations, PJM has allowed the clearing of annual coupled DR in 1st pass.

This assumption results in lower annual clearing prices relative to prices that would result from using the alternative assumption of allowing for clearing of only uncoupled annual in 1st pass.

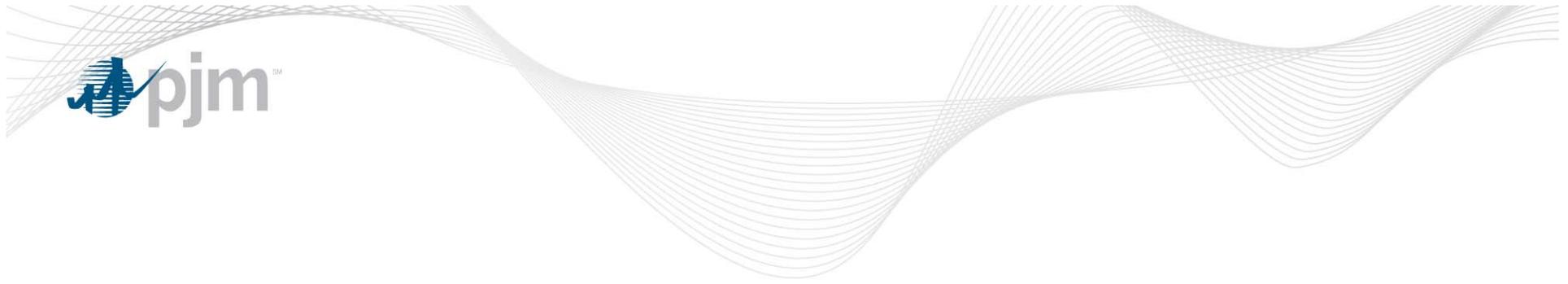
A rule regarding clearing of coupled annual DR offers would be needed if this proposal is pursued.



Assumptions used in simulation of Alternative Proposal (cont.)

- The 1st pass solution is used to determine the commitment of annual resources and to determine the quantity of additional resources needed to meet the reliability requirement of the RTO and each LDA
- Rules are needed to address whether resources committed in the 1st pass can be uncommitted in 2nd pass or if these commitments should be locked in. The requirement to procure up to but no more than LDA reliability requirement in 2nd pass causes a possible over procurement in the parent LDA if annual commitments are locked in.
 - For example, if after the 1st pass, 1000 MW of additional capacity are needed for PS-North LDA to meet its reliability requirement but only 500 MW of additional capacity are needed for the parent PSEG to meet its reliability requirement, then procuring an additional 1000 MW in PS-North LDA as required in the 2nd pass would inherently mean that 500 MW of initial annual resource commitment in rest of PSEG LDA would need to be backed down so as to not commit more than reliability requirement in PSEG LDA
 - **In simulations, PJM has allowed the commitments to change between the first and second pass in order to always procure exactly to RTO/LDA Reliability Requirement.**

- DR with potential to qualify as either Limited, Extended Summer or Annual DR may submit coupled sell offers for each capacity type for which it qualifies at different prices and clearing algorithm will select the sell offer that yields the lowest cost solution
- Under current implementation, clearing of coupled DR offers to yield lowest cost solution inherently clears such offers to yield highest economic benefit for seller (see example that follows)
- For coupled sell offers, offer price of Annual DR must be at least \$.01/MW-day greater than the offer price of coupled Ext Summer DR; and offer price of Ext Summer DR must be at least \$.01/MW-day greater than offer price of coupled Limited DR



Appendix

- Example of Coupled DR Sell Offer

Couple Name	Resource		1	2	3	4	Total
Existing PECO Couple	Limited	Min	0	0	0	0	
		Max	30	30	20	20	
		Price	\$5	\$35	\$50	\$70	
Existing PECO Couple	Summer Ext	Min	0	0	0		
		Max	30	30	20		
		Price	\$30	\$70	\$80		
Existing PECO Couple	Annual	Min	0	0			
		Max	30	30			
		Price	\$60	\$90			
Max MW of each segment			30	30	20	20	100

- Each Segment is considered independently.
- The Sum of the Max MW of each segment is equal to the pre-registered MW total.

Scenario 1: No Price Separation between Limited, Extended Summer, or Annual

Resource Name	Type	Min MW	Max MW	Offer Price	Resource Clearing Price	Cleared MW
Resource A	Limited	0	100	\$5	\$65	100
Resource B	Extended Summer	0	80	\$30	\$65	0
Resource C	Annual	0	60	\$60	\$65	0

- Limited Offer will clear as it provides the most “profit”
 - Profit = (Clearing Price – Offer Price) * MW
 - Profit_{Limited} = (\$65 - \$5) * 100 MW = \$6000
 - Profit_{Ext Sum} = (\$65 - \$30) * 80 MW = \$2800
 - Profit_{Annual} = (\$65 - \$60) * 60 MW = \$300

Scenario 2: Price Separation between Limited and Annual: Limited Offer Clears

Resource Name	Type	Min MW	Max MW	Offer Price	Resource Clearing Price	Cleared MW
Resource A	Limited	0	100	\$5	\$75	100
Resource B	Extended Summer	0	80	\$30	\$75	0
Resource C	Annual	0	60	\$60	\$100	0

- Limited Offer will clear as it provides the most “profit”
 - Profit = (Clearing Price – Offer Price) * MW
 - Profit_{Limited} = (\$75 - \$5) * 100 MW = \$7000
 - Profit_{Ext Sum} = (\$75 - \$30) * 80 MW = \$3600
 - Profit_{Annual} = (\$100 - \$60) * 60 MW = \$2400

Scenario 3: Price Separation between Limited , Extended Summer, and Annual: Annual Offer Clears

Resource Name	Type	Min MW	Max MW	Offer Price	Resource Clearing Price	Cleared MW
Resource A	Limited	0	100	\$5	\$10	0
Resource B	Extended Summer	0	80	\$30	\$35	0
Resource C	Annual	0	60	\$60	\$100	60

- Annual Offer will clear as it provides the most “profit”
 - Profit = (Clearing Price – Offer Price) * MW
 - Profit_{Limited} = (\$10 - \$5) * 100 MW = \$500
 - Profit_{Ext Sum} = (\$35 - \$30) * 80 MW = \$400
 - Profit_{Annual} = (\$100 - \$60) * 60 MW = \$2400