Day-ahead and Real-time market offers effect on Market Clearing Engine

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1	Offer submission
2	Conditions under which various offers are considered
3	Available offers for commitment and dispatch purposes
4	Eligible offers for commitment and dispatch purposes
5	Offer selection criteria in Day-ahead (DA) and Real-time (RT) energy markets

Energy offers* include…

1. **Economic components**	2. **Operating parameters**
• Price-MW pairs (incremental offer curve) • Start-Up Cost • No-Load Cost	• Notification time • Start-up time • Minimum run time

Price-MW pairs Start-Up Cost No-Load Cost	**Operating parameters** Start time Notification time Min run time Others…

* Price-based offer, price-based PLS offer, and cost-based offers – each has economic components and Operating parameters associated with offer. Offers are also referred as schedules throughout this presentation.

Offer submission via Markets Gateway	
Cost-based resource	• Must submit at least one cost-based offer* • Can submit up to 12 cost-based offers
Price-based resource	• Must submit at least one cost-based offer • Can submit up to 12 cost-based offers • Must submit price-based PLS offer • Can submit price-based offer (non PLS)

* Cost-based offers are always parameter limited.

Conditions Under Which Price-Based PLS Offer for Price-Based Resource Is Considered

		Price-Based Resource
Non-Emergency Conditions	Capacity resource	Price-based PLS offer **is not** considered if price-based offer is available
	Energy-only resource	Price-based PLS offer **is not** considered if price-based offer is available
Emergency Conditions	Capacity resource	Price-based PLS offer **is** considered* along with price-based offer
	Energy-only resource	Price-based PLS offer **is not** considered if price-based offer is available

*Assuming capacity resource is in the area or zone in which Emergency Conditions exist
**Emergency conditions includes Maximum Generation Emergency Alert, Hot Weather Alert, Cold Weather Alert

Available Offer for Commitment and Dispatch Purpose (Cost-Based Resource)

	Capacity resource	**Energy-only resource**
Non-emergency Conditions	Cost-based offer(s)	Cost-based offer(s)
Emergency Conditions	Cost-based offer(s)	Cost-based offer(s)

	Capacity resource	Energy-only resource
Non-emergency Conditions	• Price-based offer • Cost-based offer(s)	• Price-based offer • Cost-based offer(s)
Emergency Conditions	• Price-based offer • **Price-based PLS offer** • Cost-based offer(s)	• Price-based offer • Cost-based offer(s)

If price-based offer is not submitted, then price-based PLS offer is used in place of price-based offer.

Eligible Offers for Commitment and Dispatch Purpose (DA) Cost-Based Resource

		Fail TPS test	Does not fail TPS test
Non-emergency Conditions	Capacity resource	Cost-based offer(s)	Cost-based offer(s)
	Energy-only resource	Cost-based offer(s)	Cost-based offer(s)
Emergency Conditions	Capacity resource	Cost-based offer(s)	Cost-based offer(s)
	Energy-only resource	Cost-based offer(s)	Cost-based offer(s)

Eligible Offers for Commitment and Dispatch Purpose (DA)
Price-Based Resource

Non-emergency Conditions		Fail TPS test	Does not Fail TPS test
	Capacity resource	• Price-based offer • Cost-based offer(s)	• Price-based offer
	Energy-only resource	• Price-based offer • Cost-based offer(s)	• Price-based offer
Emergency Conditions	Capacity resource	• Price-based offer • Price-based PLS offer • Cost-based offer(s)	• Price-based offer • Price-based PLS offer
	Energy-only resource	• Price-based offer • Cost-based offer(s)	• Price-based offer

If pric- based offer is not submitted, then price-based PLS offer is used in place of price-based offer.

	DA Committed resource
Resource not eligible for online TPS test	• Continue to run on day-ahead committed offer
Resource eligible for online TPS test (Resource kept online beyond DA commitment period)	• Eligible offers are same as DA market described in slides 8–9. • If committed on cost-based offer in DA, then it would continue to run on same cost-based offer. • DA Pool scheduled CTs that are not expected to run in RT and offer capped in DA are evaluated for market power in RT.

	Fails TPS test	**Does not fail TPS test**
RT committed resource from offline state	• Eligible offers are same as DA market described in slides 8–9.	• Eligible offers are same as DA market described in slides 8–9.
Resource eligible for online TPS test • RT committed units after min run time • RT must run units after one hour of operation	• If resource running on cost-based offer, then continue to run on same cost-based offer. • If resource running on price-based or price-based PLS offer, then eligible offers are determined as described in slide 9.	• Resource continue to run on the same offer as it is currently running.

Resource shall remain offer capped once it is offer capped in RT market until the earlier of:

- The resource is released from its commitment by PJM dispatch

- The end of the operating day

- The start of the resource's next pre-existing commitment

Resource will be committed and dispatched on a schedule based on lowest Total Dispatch Cost among all eligible schedules as below

DISPATCH COST FOR THE APPLICABLE HOUR =
[(Incremental Energy Offer@Economic Minimum for the hour [$/MWh]*Economic Minimum for the hour[MW]) + No-Load Cost for the hour ($/H)]

TOTAL DISPATCH COST =
sum of hourly dispatch cost over a resource's minimum run time ($) + Start-Up Costs ($)

Each of eligible offers described in slide 8–9 is modeled as logical resource in MCE.

- The offer that minimizes the objective function (i.e., system production cost) of MCE formulation is selected for commitment and dispatch purpose.

Impact With Multi-Schedule Model in MCE
(During HWA/CWA/ Max Gen Alert)

Each schedule of a resource is essentially modeled as a logical resource in MCE.

If a resource has two schedules then, from MCE perspective, there are two logical resources.

The day-ahead commitment software solution time increases by approximately 10 times compared to a normal operating day.

- This Performance Impact due to multi-schedule model in MCE is still manageable with the current 2.5-hour day-ahead solution time window.

Real-time uses preferred schedule based on predefined formula.

Performance Impact With Multi-Schedule Model in MCE
(During HWA/CWA/Max Gen Alert)

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Configuration based models

Each configuration of a combined cycle plant/Energy Storage resource will essentially be modeled as a logical resource in MCE.

A typical 2X1 combined cycle plant has six configurations. Hence, there will be six logical resources for a combined cycle plant per schedule in MCE. For two schedules, there will be 12 logical resources for MCE for six configurations with two schedules.

Schedule specific transition matrix will further add additional constraints, complexity and solution time.

As solution time is not linearly proportional to number of resources, we expect the solution time to drastically increase for commitment software.