Performance Impact of Multi-Schedule Model on Market Clearing Engine (MCE)

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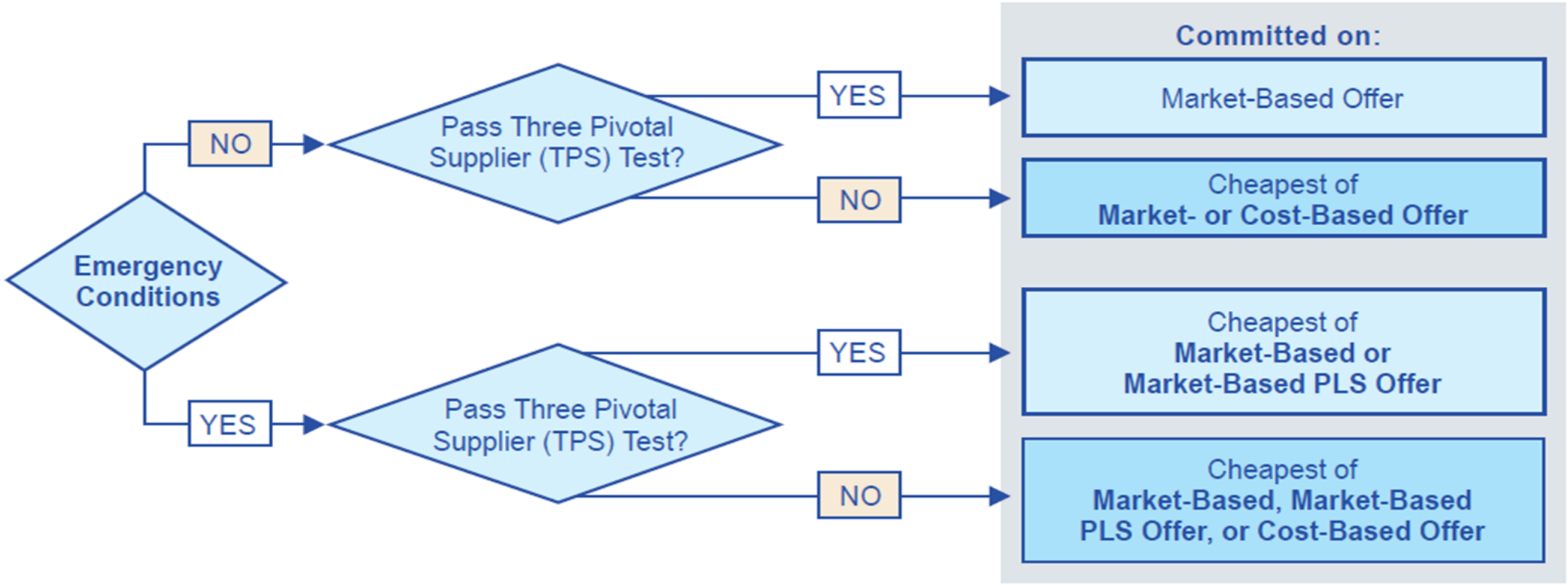
Background

- Three types of offer schedules are submitted by Market Participants – Market-based offer, Market-based parameter limited(PLS) offer and Cost-based offer
- Offers used for commitment and dispatch purpose



Background (Cont.)

- Performance impact of current multi-schedule model in MCE
  - DA commitment optimization solve time increases approximately 10 times during emergency conditions compared to normal day.
  - Currently manageable in the 2.5 hour Day-ahead (DA) market clearing window.
- Significant performance impact anticipated with nGEM multi-configuration based models for Combined Cycle and Energy Storage/Hybrid resource if current multi-schedule model in MCE is retained.

Package A (PJM Package)

Most of the design components identified during stakeholder discussion will remain as Status Quo in Package A:

- Submission of offers
- Available offers for commitment and dispatch purpose
- Eligible offers for commitment and dispatch purpose
- Components of Offer
  - Operating parameters of offer
  - Economic component of offer

Package A (PJM package -Cont.)

The following design components will change from Status Quo in Package A:

- Offer Selection Approach
  - Status Quo for Real-Time Market (RT) – Formulaic approach
  - Introduce a formulaic approach for Day-ahead Market (DA) based on following formula

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($) + start-up cost ($)

The offer type that results in the lowest Total Dispatch Cost will be selected for commitment and dispatch purpose.

* Total hourly dispatch cost will use the highest hourly cost for equivalent hours as minimum run time.

Package A (PJM package - Cont.)

The following design components will change from Status Quo in Package A (cont..):

- Application of Offer Selection Approach (Both DA and RT)
  - For all resource types other than those use configuration based models - Apply the formulaic approach as described in slide 5
  - For Combined Cycle Model – Apply the formulaic approach described in slide 5 on the highest configuration that can start from plant offline state. The offer type selected on highest configuration will be used for all configurations
  - For Energy Storage and Hybrid Resource Model - Apply the formulaic approach as described in slide 5 on discharge side of the offer curve

Package B (PJM/GT Power Joint Package)

The following design components will remain as Status Quo in Package B:

- Submission of offers
- Available offers for commitment and dispatch purpose
- Components of Offer
  - Operating parameters of offer
  - Economic component of offer

Package B (PJM/GT Power Joint Package -Conti..)

The following design components will change from Status Quo in Package B:

- Eligible offers for commitment and dispatch purpose
- Offer selection approach (DA, RT – Status Quo)
  - Application of offer selection approach (Both DA and RT)

Package B (PJM/GT Power Joint Package -Conti..) – Eligible offers for commitment and dispatch purpose (Price-based resources)

		Fail TPS test*	Does not Fail TPS test
Non-emergency Conditions	Capacity resource	• Cost-based offer(s) ~~• Price-Based offer~~	• 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

- All Cost based offer(s) will be used for cost-based resources under all conditions (i.e. emergency conditions, non-emergency conditions, resource fails TPS test, resource doesn't fail TPS test). If price-based offer is not submitted for price-based resource then price-based PLS offer will be used. *Resource fails the TPS test and eligible for offer capping. Red striped texts are part of status-quo along with black texts.
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Package B (PJM/GT Power Joint Package –Offer Selection Approach (Cont.)

The Offer selection approach will change for Day-ahead Market

- Day-ahead Market will use similar formulaic approach as Real-Time Market

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($) + start-up cost ($)

The cost offer that results in the lowest Total Dispatch Cost will be selected for commitment and dispatch purpose.

* Total hourly dispatch cost will use the highest hourly cost for equivalent hours as minimum run time.

Package B (PJM/GT Power Joint Package) – Application of offer selection approach (Cont.)

- For all resource types other than those use configuration based models - Apply the formulaic approach as described in slide 10.
- For Combined Cycle Model – Apply the formulaic approach described in slide 10 on the highest configuration that can start from plant offline state. The cost offer selected on highest configuration will be used for all configurations
- For Energy Storage and Hybrid Resource Model - Apply the formulaic approach as described in slide 10 on discharge side of the offer curve

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Appendix

Example – Application of formulaic approach for Configuration Based Model (Combined Cycle)

- The formulaic approach will be applied to highest configuration* that can be started from plant offline state. In this example, the assumption is that all of the available configuration can be started from offline state i.e. CT1+CT2+Steam configuration will be used to determine the cheapest schedule type.
- Once cheapest schedule type is determined, the same schedule type will be considered for all of the available configurations for commitment and dispatch purpose.

*Highest Configuration will typically have the highest MW available from the plant offline state and is more efficient in terms of cost.

Example – Application of formulaic approach for Configuration Based Model (Combined Cycle)

- The following information (current and next slide) is needed from data submitted for Combined Cycle Plant to apply the formulaic approach

Configurations	Incremental Energy Offers ($/MWh)			EcoMin (MW)	EcoMax (MW)	No-load Cost ($/Hr)	Start-up Cost ($)
	Price Schedule	Price PLS Schedule	Cost Schedule				
CT1	20	20	15	100	100	1000	10000
CT2	20	20	15	100	100	1000	10000
CT1+CT2	15	17	12	200	200	2000	15000
CT1+Steam	15	17	12	100	300	1500	15000
CT2+Steam	20	20	13	100	300	1500	15000
CT1+CT2+Steam	15	14	11	200	400	1500	20000

*EcoMin, EcoMax, No-load Cost, Start-up Cost are also at schedule level but to simplify the example, it is considered as one value for each configuration.

*The Incremental Energy Offers, EcoMin, No-load Cost and Start-up Cost of CT1+CT2+Steam configuration will be used in calculation of hourly and Total Dispatch Cost formula under this example.

*In this example, it is assumed that all of the configurations can be started from offline state.

Example – Application of formulaic approach for Configuration Based Model (Combined Cycle)

- The following information is needed from data submitted for Combined Cycle Plant to apply the formulaic approach

Components of Combined Cycle Plant	Minimum Run Time (Hrs)		
	Price Schedule	Price PLS Schedule	Cost Schedule
CT1	3	2	1
CT2	3	1	1
Steam	6	4	3

*For the purpose of calculating Total Dispatch Cost, the minimum run time for CT1+CT2+Steam configuration will be equal to 6,4, and 3 for Price, Price PLS, and Cost Schedule respectively.