Schedule Selection
IMM Package

MIC

August 9, 2023

IMM

Monitoring Analytics

Issue

- **Implementation of combined cycle modeling requires that PJM shorten the computational time of the market clearing engine (MCE) by selecting offer schedules using a rule based approach rather than optimization.**

- **There are problems with the current offer schedule selection process that undermine market power mitigation.**

- **Solving the market power mitigation issues will also shorten MCE computational time.**

Current Offer Capping

- **The current offer capping process allows sellers with market power to:**
  - **Set LMPs with high markups;**
  - **Withhold using high offers and inflexible parameters;**
  - **Extract unnecessary uplift from the market.**
- **The IMM has several longstanding recommendations to fix the offer capping process.**

Proposals

- The MIC special sessions have resulted in three proposals for changing the way offer schedules are used in the market unit commitment process.
- All three proposals meet PJM's desired goal of reducing the computational time of the day ahead market.
- The IMM proposal resolves the market power mitigation issues.
- The GT Power Group proposal also resolves these issues, but creates new issues by not selecting the most economic schedule.

Proposals

- **The PJM package would create unacceptable flaws in how units are committed.**
- **The GT Power Group package has the same issues, but to a lesser extent.**
  - **Issues result from revisions to this package by PJM.**

Problems with PJM's Proposal

Feature of PJM Proposal	Implication
• Cost evaluated only at economic minimum output level.	• No points on the offer curve are evaluated for markup above eco min.
• Minimum run time is the only parameter that enters the dispatch cost formula.	• No parameters on the offer schedule are evaluated for inflexibility other than min run time.
• Total dispatch cost sums the highest cost hours for the number of hours in the min run time.	• No hourly offers are evaluated if they have an hourly dispatch cost less than the highest ranked hours.
• Offer schedule selection is based on a (perhaps nonsequential) subset of hours.	• The actual commitment of the unit could be in different hours from the hours evaluated.

Comparison of Proposals by Scenario

Scenarios	PJM	GT Power Group	IMM
Price based unit fails the TPS test, one cost offer available	Apply total dispath cost formula to two offer schedules	Cost offer commitment	Choose lowest offer points and most flexible parameters between price and cost offers
Price based unit fails the TPS test, dual fuel cost offers available	Apply total dispath cost formula to three offer schedules	Apply total dispatch cost formual to choose between gas and oil cost offers	Choose lowest offer points and most flexible parameters between price and reference cost offer based on most economic fuel for each hour.
Cost based unit	Apply total dispath cost formula to all available cost schedules	Apply total dispath cost formula	Market seller chooses one offer or Market clearing engine chooses.
Price based unit on emergency or alert day	Apply total dispath cost formula to price and price PLS schedules	Price PLS commitment	Choose price offer points. Choose most flexible parameters between price and cost offers.
Price based unit on emergency or alert day fails the TPS test, one cost offer available	Apply total dispath cost formula to all three offer schedules	Cost offer commitment	Choose lowest offer points and most flexible parameters between price and cost offers
Price based unit on emergency or alert day, dual fuel cost offers available	Apply total dispath cost formula to price and price PLS schedules	Price PLS commitment	Choose price offer points. Choose most flexible parameters between price and reference cost offer.
Price based unit on emergency or alert day fails the TPS test, dual fuel cost offers available	Apply total dispath cost formula to all four offer schedules	Apply total dispatch cost formual to choose between gas and oil cost offers	Choose lowest offer points and most flexible parameters between price and reference cost offer

Dual Fuel Unit Commitment

- **The flaws with PJM's proposal can be illustrated with an example of a dual fuel unit on a day with a large change in gas prices.**
- **The IMM constructed an example based on representative costs for actual units and actual fuel prices from February 3, 2023.**
- **The example offer schedules were input in the calculation spreadsheet provided by PJM to demonstrate its proposal.**

Example Daily Parameters for Dual Fuel Unit

Table 1 - Daily Resource Parameters and Cost

Resource offers or Schedules	Maximum Run Time (hrs)	Minimum Run Time (hrs)	Daily Cold Start Up cost ($)	Daily No Load Cost ($/hr)
Price Schedule	24	12	$ 10,000.00	$ 8,000.00
Price PLS Schedule	24	6	$ 10,000.00	$ 8,000.00
Cost Schedule 1 (Gas)	24	6	$ 10,000.00	$ 9,000.00
Cost Schedule 2 (Oil)	24	6	$ 50,000.00	$ 45,000.00

Example Hourly Price Offer Based on Gas

Table 2 - Incremental Energy Offers

	HE1-HE10,HE23-HE24		HE11-HE22	
Price Schedule (gas)	MW	Price ($/MWh)	MW	Price ($/MWh)
	200	15	200	120
	300	20	300	160
	500	25	500	200
	501	500	501	500

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Example Hourly Cost Offers

	HE1-HE10,HE23-HE24		HE11-HE22	
Cost Schedule 1 (gas)	MW	Price ($/MWh)	MW	Price ($/MWh)
	200	20	200	160
	300	25	300	200
	500	30	500	240
	501	35	501	280

	HE1-HE10,HE23-HE24		HE11-HE22	
Cost Schedule 2 (oil)	MW	Price ($/MWh)	MW	Price ($/MWh)
	200	100	200	100
	300	125	300	125
	500	150	500	150
	501	175	501	175

Gas is the economic fuel for commitment for gas day 1, but oil for gas day 2.

Application of PJM Dispatch Cost Formula

Table 4 - Total Dispatch Cost

	Solution Option 4(A):Total Dispatch Cost over Min Run (largest values for equivalent hours of min run time) using EcoMin	
Price Schedule	$	1,136,000.00
Price PLS Schedule	$	608,000.00
Cost Schedule 1 (gas)	$	704,000.00
Cost Schedule 2 (oil)	$	440,000.00

The oil cost schedule is selected regardless of the time of day.

Unacceptable Outcome

- **The PJM proposed dispatch cost formula simplifies too much. It ignores hourly offers for many hours of the day, which is a particular issue for gas and dual fuel resources.**
- **It is unacceptable for the market to commit a resource on its oil cost offer when its gas cost offer is available and more economic.**
- **If the example unit failed the TPS test and was needed during gas day 1, when gas is lower cost, PJM's proposal would commit it on the oil offer anyway.**

IMM Approach – Option 1

- No market selection of the entire schedule.
- The lowest financial parameters are chosen for start up, no load, and the offer curve.
- The most flexible operating parameters are chosen.
- Market seller designates a single cost-based offer for comparison with price-based offer to ensure consistent offers and parameters.
- The cost-based offer must use the most economic fuel type for each hour.
- The market seller is responsible for correctly selecting among multiple cost offers.

Example IMM Approach

Financial Parameters	Price Offer	Cost Offer	Mitigated Offer
Start Cost	3,500	4,000	3,500
No Load Cost	1,000	1,000	1,000
Incremental Offer Curve	$/MWh	$/MWh	$/MWh
0 MW	15	20	15
50 MW	15	25	15
100 MW	15	30	15
150 MW	500	35	35
200 MW	500	40	40

Example IMM Approach

Operating Parameters	Price Parameters	Parameter Limits	Mitigated Parameters
Min Down Time	8.0	7.0	7.0
Min Run Time	24.0	2.0	2.0
Max Run Time	4.0	24.0	24.0
Notification Time	4.0	1.0	1.0
Start Time	3.0	3.0	3.0
Turn Down Ratio	2.0	1.5	2.0
Max Daily Starts	3.0	3.0	3.0
Max Weekly Starts	21.0	21.0	21.0

IMM Approach – Option 2

- The market clearing engine (MCE) currently selects among multiple cost-based schedules.
  - This functionality is valuable, especially for dual fuel resources.
- IMM Option 2 preserves MCE schedule selection along with the option to designate a single cost-based offer for offer capping the price-based offer, as in IMM Option 1.
- To ensure market power mitigation is effective, the MCE schedule selection chooses among only cost-based offers.

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