Advanced Scheduling Proposal

MIC

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Advanced Scheduling Proposal

- **In the August MIC, several stakeholders provided feedback regarding the PJM/IMM proposal.**
- **The next slides cover the requests made.**

Advanced Scheduling Timing

- There is no perfect timing
  - If offer data is requested too early, such data will contain a lower confidence level. Same applies to load forecast.
  - If offer data is requested too late, PJM will not have enough time to run the advanced commitment model for timely posting results.
- The proposal needs to balance these two issues.

Advanced Scheduling Timing

- **We are proposing two options:**

18:00 Advanced Commitment Emergency Procedure	PJM will announce that advanced scheduling will be made starting with day D.	D_{-2}
07:00 Advanced Commitment Offer Data Deadline	Market Sellers must update offer data.	D_{-1}
10:00 Advanced Commitment Posting Deadline	PJM posts results of advanced schedule.	
11:00 DA Market Offer Data Deadline	Market Sellers must update offer data for DAM.	
13:30 DA Market Posting Deadline	PJM posts results of DAM.	
14:15 Rebid Offer Data Deadline	Market Sellers must update offer data for rebid.	
D: Operating Day or Days		D_0

12:00 Advanced Commitment Emergency Procedure	PJM will announce that advanced scheduling will be made starting with day D.	D_{-2}
15:00 Advanced Commitment Offer Data Deadline	Market Sellers must update offer data.	
18:00 Advanced Commitment Posting Deadline	PJM posts results of advanced schedule.	
11:00 DA Market Offer Data Deadline	Market Sellers must update offer data for DAM.	D_{-1}
13:30 DA Market Posting Deadline	PJM posts results of DAM.	
14:15 Rebid Offer Data Deadline	Market Sellers must update offer data for rebid.	
D: Operating Day or Days		D_0

Indicative Offers

- Indicative Offer: Offer estimate to be used by PJM for advanced unit scheduling.
- Only units that self identify as being at risk will be required to submit an Indicative Offer.
- Other units identified by PJM as at risk, may submit an Indicative Offer but are not required to do so.
- Indicative Offers will limit the amount of uplift owed to the units.
- Markets Gateway allows values up to $9,999/MWh.
- Market Sellers can reflect their price risk aversion level in their Indicative Offer.

Indicative Offer

- One of the goals of this initiative is to only procure in advance the amount of MW that are needed to meet PJM's load and reserve requirements considering a reasonable level of generation performance risk.
- If no unit submits an Indicative Offer, the proposal is similar to status quo with the added benefit that PJM will not necessarily commit all gas fired units.
- All units are still required to offer into the DA and RT markets.
- Market Sellers will have to weigh the benefits of submitting an Indicative Offer against not receiving an advanced commitment.

Settlement Examples

- **The following examples show different settlement outcomes depend on:**
  - **Use and level of energy offers**
  - **DA Clearing**
  - **PJM manual dispatch instruction**

Example 1

- Unit identified as at risk by PJM.
- Unit does not provide an Indicative Offer.
- Unit operates in RT as committed in advanced scheduling process.

Example 1

Offer	$/MWh
Indicative Offer	NA
DA Offer	$1,300
RT Final Offer	$1,125

Settlements	Total
DA Revenues	$0
Balancing Revenues	$2,590,000
Energy Offer	$5,400,000
Uplift	$2,810,000

Offer Used For Uplift	$/MWh
RT Final Offer	$1,125

Hour	Commitment (MWh)	DA Output (MWh	RT Output (MWh)	DA LMP ($/MWh)	RT LMP ($/MWh)
0	100	0	100	$800	$400
1	100	0	100	$800	$500
2	100	0	100	$700	$200
3	100	0	100	$800	$300
4	300	0	300	$700	$500
5	300	0	300	$800	$700
6	300	0	300	$1,000	$1,100
7	300	0	300	$1,400	$1,100
8	300	0	300	$1,000	$900
9	300	0	300	$800	$600
10	100	0	100	$500	$100
11	100	0	100	$400	$100
12	100	0	100	$400	$100
13	100	0	100	$300	$100
14	100	0	100	$300	$100
15	100	0	100	$300	$200
16	300	0	300	$500	$500
17	300	0	300	$700	$1,100
18	300	0	300	$1,000	$300
19	300	0	300	$1,000	$300
20	300	0	300	$1,000	$400
21	300	0	300	$1,000	$300
22	100	0	100	$600	$200
23	100	0	100	$500	$200

Example 2 and 3

- **Unit self identified as at risk.**
- **Unit provides an Indicative Offer.**
  - **Example 2: Indicative Offer < Final Offer**
  - **Example 3: Indicative Offer > Final Offer**
- **Unit operates in RT as committed in advanced scheduling process.**

Example 2

Offer	$/MWh
Indicative Offer	$1,000
DA Offer	$1,300
RT Final Offer	$1,125

Settlements	Total
DA Revenues	$0
Balancing Revenues	$2,590,000
Energy Offer	$4,800,000
Uplift	$2,210,000

Offer Used For Uplift	$/MWh
Indicative Offer	$1,000

Hour	Commitment (MWh)	DA Output (MWh	RT Output (MWh)	DA LMP ($/MWh)	RT LMP ($/MWh)
0	100	0	100	$800	$400
1	100	0	100	$800	$500
2	100	0	100	$700	$200
3	100	0	100	$800	$300
4	300	0	300	$700	$500
5	300	0	300	$800	$700
6	300	0	300	$1,000	$1,100
7	300	0	300	$1,400	$1,100
8	300	0	300	$1,000	$900
9	300	0	300	$800	$600
10	100	0	100	$500	$100
11	100	0	100	$400	$100
12	100	0	100	$400	$100
13	100	0	100	$300	$100
14	100	0	100	$300	$100
15	100	0	100	$300	$200
16	300	0	300	$500	$500
17	300	0	300	$700	$1,100
18	300	0	300	$1,000	$300
19	300	0	300	$1,000	$300
20	300	0	300	$1,000	$400
21	300	0	300	$1,000	$300
22	100	0	100	$600	$200
23	100	0	100	$500	$200

Example 3

Offer	$/MWh
Indicative Offer	$1,500
DA Offer	$1,300
RT Final Offer	$1,125

Settlements	Total
DA Revenues	$0
Balancing Revenues	$2,590,000
Energy Offer	$5,400,000
Uplift	$2,810,000

Offer Used For Uplift	$/MWh
RT Final Offer	$1,125

Hour	Commitment (MWh)	DA Output (MWh	RT Output (MWh)	DA LMP ($/MWh)	RT LMP ($/MWh)
0	100	0	100	$800	$400
1	100	0	100	$800	$500
2	100	0	100	$700	$200
3	100	0	100	$800	$300
4	300	0	300	$700	$500
5	300	0	300	$800	$700
6	300	0	300	$1,000	$1,100
7	300	0	300	$1,400	$1,100
8	300	0	300	$1,000	$900
9	300	0	300	$800	$600
10	100	0	100	$500	$100
11	100	0	100	$400	$100
12	100	0	100	$400	$100
13	100	0	100	$300	$100
14	100	0	100	$300	$100
15	100	0	100	$300	$200
16	300	0	300	$500	$500
17	300	0	300	$700	$1,100
18	300	0	300	$1,000	$300
19	300	0	300	$1,000	$300
20	300	0	300	$1,000	$400
21	300	0	300	$1,000	$300
22	100	0	100	$600	$200
23	100	0	100	$500	$200

Example 4

- Unit identified as at risk by PJM.
- Unit does not provide an Indicative Offer.
- Unit clears DA.
- Unit operates in RT following dispatch between min and max.

Example 4

Offer	$/MWh
Indicative Offer	NA
DA Offer	$200
RT Final Offer	$225

Settlements	Total
DA Revenues	$5,190,000
Balancing Revenues	($260,000)
Energy Offer	$1,080,000
Uplift	$0

Offer Used For Uplift	$/MWh
DA Offer	$200

Hour	Commitment (MWh)	DA Output (MWh	RT Output (MWh)	DA LMP ($/MWh)	RT LMP ($/MWh)
0	100	300	300	$800	$400
1	100	300	300	$800	$500
2	100	300	100	$700	$200
3	100	300	300	$800	$300
4	300	300	300	$700	$500
5	300	300	300	$800	$700
6	300	300	300	$1,000	$1,100
7	300	300	300	$1,400	$1,100
8	300	300	300	$1,000	$900
9	300	300	300	$800	$600
10	100	300	100	$500	$100
11	100	300	100	$400	$100
12	100	300	100	$400	$100
13	100	300	100	$300	$100
14	100	300	100	$300	$100
15	100	300	100	$300	$200
16	300	300	300	$500	$500
17	300	300	300	$700	$1,100
18	300	300	300	$1,000	$300
19	300	300	300	$1,000	$300
20	300	300	300	$1,000	$400
21	300	300	300	$1,000	$300
22	100	300	100	$600	$200
23	100	300	100	$500	$200

Example 5

- Unit identified as at risk by PJM.
- Unit does not provide an Indicative Offer.
- Unit operates in RT as committed in advanced scheduling process until PJM has to reduce the unit's output due to reliability.

Example 5

Offer	$/MWh
Indicative Offer	NA
DA Offer	$1,300
RT Final Offer	$1,125

Unrecovered Gas Cost	MMBtu
Purchased Gas	36,000
Consumed Gas	27,000
Unused Gas	9,000

Gas Cost	$/MMBtu
Purchase Price	$150
Disposal Price	$50

Settlements	Total
DA Revenues	$0
Balancing Revenues	$2,010,000
Energy Offer	$4,050,000
Unrecovered Gas Cost	$900,000
Uplift	$2,940,000

Offer Used For Uplift	$/MWh
RT Final Offer	$1,125

Hour	Commitment (MWh)	DA Output (MWh	RT Output (MWh)	DA LMP ($/MWh)	RT LMP ($/MWh)
0	100	0	100	$800	$400
1	100	0	100	$800	$500
2	100	0	100	$700	$200
3	100	0	100	$800	$300
4	300	0	300	$700	$500
5	300	0	300	$800	$700
6	300	0	300	$1,000	$1,100
7	300	0	300	$1,400	$1,100
8	300	0	300	$1,000	$900
9	300	0	300	$800	$600
10	100	0	100	$500	$100
11	100	0	100	$400	$100
12	100	0	100	$400	$100
13	100	0	100	$300	$100
14	100	0	100	$300	$100
15	100	0	100	$300	$200
16	300	0	100	$500	$500
17	300	0	100	$700	$1,100
18	300	0	100	$1,000	$300
19	300	0	100	$1,000	$300
20	300	0	100	$1,000	$400
21	300	0	100	$1,000	$300
22	100	0	100	$600	$200
23	100	0	100	$500	$200

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Goal

- The goal is to have a transparent process in which units are committed economically based on the known constraints and explicit commitment instructions are given.
- Areas of interest:
  - Communications
  - Tools and inputs
  - Offers and FCPs
  - Uplift
  - Transparency
  - Settlements

COMMUNICATIONS

Communications

- **PJM will notify in advance when these commitments will be made based on system assessment.**
  - **New emergency procedure to provide notification.**
  - **The alert will include a deadline by which units' information must be updated.**
  - **A second notification will be sent when commitments are posted.**
- **PJM will provide electronic commitments (same as DA).**
  - **The commitments will include start and end times.**
  - **The commitments will include hourly MW profile.**
  - **Information will be posted in Markets Gateway.**

INPUTS AND TOOLS

Inputs and Models

- **Advanced unit scheduling will be the result of a commitment tool that looks ahead multiple days.**
- **Objective function is to minimize production cost using:**
  - **PJM's load forecast**
  - **Generation availability from Markets Gateway**
  - **Generation at risk**
    - Natural gas procurement
    - Cold weather temperature limits
  - **Interchange assumptions**
  - **Demand response availability**

Generation at Risk

- **Units at risk will receive advanced commitments.**
- **Categories of risk:**
  - **Cold Weather Operating Risk: Units with cold weather start and operating limits above forecasted temperatures will be considered at risk.**
  - **Gas Procurement Risk.**
    - Units that indicate to PJM that they are at risk of lack of fuel if not committed prior to the Day-Ahead Energy Market and/or
    - Units that PJM determines are at risk due to historical performance and system conditions.

Generation at Risk

- Units will indicate to PJM that they are at risk (self identified) via eDART (prior to the start of the winter season) and again in Markets Gateway (when the advanced scheduling process is triggered).
- PJM will evaluate all gas units and units that are expected to face temperatures below their cold weather operating limits.
- PJM will determine which units will receive advanced commitments based on PJM's risk assessment.
- Units at risk statistics (e.g. number and MW) will be posted after the fact.

Offers

- **PJM will need offers before the DA deadline to do an economic evaluation of which units at risk will be committed in advance of the DAM.**
- **Today, generators submit nonbinding offers for the next seven days.**
- **Units that self identify as at risk will have to submit an Indicative Offer.**
- **Indicative Offer: Offer estimate to be used by PJM for advanced unit scheduling.**
- **Uplift payments will be capped based on the Indicative Offer.**

Offers

- **Units identified as at risk by PJM (not self identified) may, but do not have to, submit Indicative Offers.**
  - **If an Indicative Offer is not provided, unit will be placed at the end of the supply stack.**
  - **If an Indicative Offer is not provided, uplift remains status quo (committed or final offers).**
- **Units not identified as at risk will not receive advanced commitments, but may submit Indicative Offers.**
  - **If Indicative Offer is not provided, PJM will use unit's nonbinding seven day offer forecast.**
  - **In any case, uplift remains status quo.**

Offers Summary

- **Unit at risk (self identified): Must provide Indicative Offer.**
- **Unit at risk (identified by PJM): May provide Indicative Offer, but if not, will be part of the group of units committed last.**
- **Unit at risk (cold operating limit): May provide Indicative Offer, but if not, will be part of the group of units committed last.**
- **Unit not at risk: May provide Indicative Offer, but if not, PJM will use nonbinding seven day offers in Markets Gateway.**

Operating Parameters

- **Units committed in advanced will be allowed to increase their economic minimum to match their advanced scheduling profile.**
- **Gas packages will not be modeled as multiday minimum run times.**
- **If necessary, units will be committed for specific days.**
- **Pipeline ratable takes will continue to be enforced via PLS exceptions.**

Other Inputs

- **Interchange: Any delisted capacity (capacity that has been committed outside of PJM) will be assumed to be exported.**
- **DR: Estimated response submitted by CSPs in DR Hub based on actual reductions during comparable weather.**

FUEL COST POLICIES

FCP Changes

- All units committed in advance of the DAM must reflect actual gas price paid by units in their offers prior to start of operating day.
- Volumes:
  - Actual gas price paid must be for the volume purchased to meet PJM's advanced commitment MW.
  - Any uncommitted MW can continue to reflect the existing FCP method.
  - For example, unit is committed to run 24h at eco min. Actual price is $15/MMBtu. Incremental gas can be bought at $25/MMBtu. Offer up to eco min would be based on $15/MMBtu gas. Offer beyond eco min can be based on $25/MMBtu gas.

UPLIFT

Uplift

- For units committed in advance of the DAM, uplift will be calculated for the entire commitment period (no longer daily or segmented).
  - This could include multiple days.
- All uplift will be allocated as reliability charges. Reliability charges are allocated to real time load plus exports.

Unrecovered Gas Costs

- **PJM will provide MW commitments, as done DA today.**
- **Units will have the ability to:**
  - **Set eco min to this MW level, or**
  - **Leave eco min flexible.**
- **PJM can request units to operate below this eco min and/or decommit.**
- **These actions will be taken for reliability only (e.g. emergency min events, constraint management) and not based on economics.**

Unrecovered Gas Costs

- When reduced or cancelled by PJM for reliability, Market Sellers will provide PJM/IMM calculations of any resultant fuel loss calculations including supporting documentation.
- PJM/IMM will review information.
- Only transactions that were the result of PJM's advanced scheduling and PJM's reduction/cancellation instruction will be included.
- The final value will be included as a cost component in the uplift calculation.

Committed Offer

- **Uplift is limited to the lesser of the Committed Offer and Final Offer.**
- **Committed Offer:**
  - **The Indicative Offer (for self identified units), if provided, in effect at the time the resource receives the advance scheduling instruction, or**
  - **The Day-Ahead Market offer, if an Indicative Offer was not provided.**

TRANSPARENCY

Data Posting

- **IMM/PJM will post data on commitments from advanced scheduling, including:**
  - **Number of units**
  - **Energy (MWh) by hour**
  - **By reason committed in advance of the DAM:**
    - Transmission constraints
    - Conservative operations
- **Data posting will not be subject to confidentiality limitations (three owners or less).**