Flexible Resources BOR Treatment

MIC Special Session - Operating Reserve Clarification for Resources Operating as Requested by PJM

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Flexible Resources

- **Flexible Resources are not assumed to run in real time for their entire day ahead schedule. Instead, Flexible Resources remain offline until committed by PJM in real time or self scheduled.**
- **If not committed by PJM in real time, Flexible Resources are eligible to receive Lost Opportunity Cost (LOC) Credits to cover losses in excess of DA revenues from DA buy back and/or forgone profits.**

Flexible Resources Energy LOC

- **Flexible Resources are generators eligible to be called on in real time that have a two hour or less time to start and a two hour or less minimum run time.**
- **Flexible Resources are paid LOC when not committed by PJM while having a DA award.***
- **The LOC equals the higher of:**
  A. **DA MW x (RT LMP – DA LMP)**
  B. **DA MW x (RT LMP – Offer **)**

*** Only the subset of Flexible Resources that are not expected to run in real-time unless called by PJM are eligible for this LOC credit (e.g. CTs).**

**** The offer equals the area under the incremental offer curve plus no load cost plus start cost (if the unit does not start during any hour of the DA award).**

Flexible Resources Energy LOC

- **The LOC compensation preserves Flexible Resources' DA net revenue when not committed by PJM.**
- **When the resource does not run, it incurs a buy back cost (negative balancing revenues).**
  - **The buy back results in a loss when RT LMP is greater than DA LMP.**
  - **The buy back only results in an LOC when the RT LMP is greater than the unit's offer.**

LOC Example

- **Unit clears DA for four hours.**
- **Unit Offer:**

Incremental Offer (Stepped Curve)

MW	Price ($/MWh)	Area Under Curve
50	25	$1,250
100	30	$2,750
150	55	$5,500

No Load Cost ($/hour)	$800
Start Cost ($/start)	$1,000

LOC Example 1

- Unit is not committed by PJM.
- RT LMP = DA LMP.
- Unit is expected to make $7,300.
- Because it did not run:
  - It incurs a buy back of $28,000
  - Without LOC, the unit net revenue would be zero = $28,000 (DA Rev) - $28,000 (Bal Rev)
- The LOC makes the unit whole to its DA net revenue ($7,300).

Hour	**14**	**15**	**16**	**17**	
DA LMP ($/MWh)	50	50	60	60	
DA Generation (MWh)	100	100	150	150	
RT LMP ($/MWh)	50	50	60	60	
RT Generation (MWh)	0	0	0	0	
Commitment Status	Offline	Offline	Offline	Offline	
Day-Ahead					**Total**
DA Revenues	$5,000	$5,000	$9,000	$9,000	$28,000
DA Incremental Offer	$2,750	$2,750	$5,500	$5,500	$16,500
DA No Load Cost	$800	$800	$800	$800	$3,200
DA Start Cost	$250	$250	$250	$250	$1,000
DA Net Revenue	$1,200	$1,200	$2,450	$2,450	$7,300
Real-Time / Balancing					**Total**
Balancing Revenues	($5,000)	($5,000)	($9,000)	($9,000)	($28,000)
LOC Credit (A)	$0	$0	$0	$0	
LOC Credit (B)	$1,200	$1,200	$2,450	$2,450	
LOC Credit	$1,200	$1,200	$2,450	$2,450	$7,300
RT Incremental Offer	$0	$0	$0	$0	$0
RT No Load Cost	$0	$0	$0	$0	$0
RT Start Cost	$0	$0	$0	$0	$0
					Total
Net Revenue	$1,200	$1,200	$2,450	$2,450	$7,300
				BOR Credit	$0

LOC Example 2

- Unit is not committed by PJM.
- RT LMP > DA LMP.
- Unit is expected to make $7,300.
- Because it did not run:
  - It incurs a buy back of $33,000
  - Without LOC, the unit net revenue would be negative = $28,000 (DA Rev) - $33,000 (Bal Rev)
- The LOC makes the unit whole to its DA net revenue ($7,300) + buy back loss ($5,000) for a total LOC of $12,300.

Hour	**14**	**15**	**16**	**17**	
DA LMP ($/MWh)	50	50	60	60	
DA Generation (MWh)	100	100	150	150	
RT LMP ($/MWh)	60	60	70	70	
RT Generation (MWh)	0	0	0	0	
Commitment Status	Offline	Offline	Offline	Offline	
Day-Ahead					**Total**
DA Revenues	$5,000	$5,000	$9,000	$9,000	$28,000
DA Incremental Offer	$2,750	$2,750	$5,500	$5,500	$16,500
DA No Load Cost	$800	$800	$800	$800	$3,200
DA Start Cost	$250	$250	$250	$250	$1,000
DA Net Revenue	$1,200	$1,200	$2,450	$2,450	$7,300
Real-Time / Balancing					**Total**
Balancing Revenues	($6,000)	($6,000)	($10,500)	($10,500)	($33,000)
LOC Credit (A)	$1,000	$1,000	$1,500	$1,500	
LOC Credit (B)	$2,200	$2,200	$3,950	$3,950	
LOC Credit	$2,200	$2,200	$3,950	$3,950	$12,300
RT Incremental Offer	$0	$0	$0	$0	$0
RT No Load Cost	$0	$0	$0	$0	$0
RT Start Cost	$0	$0	$0	$0	$0
					Total
Net Revenue	$1,200	$1,200	$2,450	$2,450	$7,300
				BOR Credit	$0

LOC Example 3

- Unit is not committed by PJM.
- RT LMP < DA LMP.
- Unit is expected to make $7,300.
- Because it did not run:
  - It incurs a buy back of $15,000
  - Without LOC, the unit net revenue is positive = $28,000 (DA Rev) - $15,000 (Bal Rev)
- There is no need for LOC because the buy back results in a profit of $13,000. Higher than the expected DA net revenue of $7,300.

Hour	**14**	**15**	**16**	**17**	
DA LMP ($/MWh)	50	50	60	60	
DA Generation (MWh)	100	100	150	150	
RT LMP ($/MWh)	30	30	30	30	
RT Generation (MWh)	0	0	0	0	
Commitment Status	Offline	Offline	Offline	Offline	
Day-Ahead					**Total**
DA Revenues	$5,000	$5,000	$9,000	$9,000	$28,000
DA Incremental Offer	$2,750	$2,750	$5,500	$5,500	$16,500
DA No Load Cost	$800	$800	$800	$800	$3,200
DA Start Cost	$250	$250	$250	$250	$1,000
DA Net Revenue	$1,200	$1,200	$2,450	$2,450	$7,300
Real-Time / Balancing					**Total**
Balancing Revenues	($3,000)	($3,000)	($4,500)	($4,500)	($15,000)
LOC Credit (A)	($2,000)	($2,000)	($4,500)	($4,500)	
LOC Credit (B)	($800)	($800)	($2,050)	($2,050)	
LOC Credit	$0	$0	$0	$0	$0
RT Incremental Offer	$0	$0	$0	$0	$0
RT No Load Cost	$0	$0	$0	$0	$0
RT Start Cost	$0	$0	$0	$0	$0
					Total
Net Revenue	$2,000	$2,000	$4,500	$4,500	$13,000
				BOR Credit	$0

Flexible Resources Energy LOC

- **The Energy LOC for flexible resources ensure that the units' net revenue remains above zero.**

Flexible Resources BOR and Energy LOC

Feature	Status Quo	Proposal
Start of Eligibility	When unit comes online	First pool scheduled hour of the DA award
Eligibility during RT self-scheduled intervals	Always ineligible	Remains eligible when within the pool scheduled DA award
DA revenues	Included	Included
Balancing revenues	Excluded	Included
LOC credits	Excluded	Included
Special treatment for losses incurred while self-scheduled	Not needed since unit is ineligible in those intervals	Needed since unit remains eligible in those intervals

Self Scheduling

- **Self scheduling in these scenarios create complexity.**
- **The balancing revenues increase because the unit runs compared to the scenario where the unit does not run.**
- **No LOC credit is paid because the unit is not offline at PJM's request.**
- **The IMM and PJM see two options for handling this complexity and ensuring Step 1 of the BOR credit calculation accounts for these revenues.**
  - **Step 2 always reflects actual operation, so no special handling is needed for Step 2. It includes all revenues whether positive or negative.**

Step 1: Option A (Presented in Sept)

- **Floor at zero the net revenues during self schedule intervals.**
  - **Max(Incremental profit/losses from self-scheduling + DA net revenues, 0) for the interval + pool scheduled net revenues from other intervals**
- **All positive net revenues in self-scheduled intervals continue to be used in the calculation.**
  - **These will be greater than the DA revenue if self-scheduling results in balancing profits.**
  - **These can also be less than the DA revenue if self-scheduling results in balancing losses that erode the DA revenue.**

Step 1: Option B (New)

- **Treat self scheduled intervals as offline.***
  - **This is consistent with the revenues the resource would have earned if it had operated as directed by PJM.**
- **Balancing revenues will reflect 0 MW in RT and LOC will be calculated for use in Step 1 only.**
  - **Actual balancing revenues will reflect actual operation and no LOC credit will be paid.**
- **DA net revenues in self scheduled intervals continue to be used in the calculation.**
  - **Additional balancing profits or losses due to self scheduling will not be included in Step 1.**

*** Tracking RLD will still be used for calculating deviations in these intervals.**

Example – Self Schedule Profit

	Status Quo Offline	Proposal Offline
DA LMP ($/MWh)	50	50
DA Generation (MWh)	100	100
RT LMP ($/MWh)	100	100
RT Generation (MWh)	0	0
Commitment Status	Offline	Offline
Day-Ahead		
DA Revenues	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750
DA No Load Cost	$800	$800
DA Start Cost	$1,000	$1,000
DA Net Revenue	$450	$450
Real-Time / Balancing		
Balancing Revenues	($10,000)	($10,000)
LOC Credit (A)	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450
LOC Credit	$5,450	$5,450
RT Incremental Offer	$0	$0
RT No Load Cost	$0	$0
RT Start Cost	$0	$0
Net Revenue Used in BOR	**$5,000**	**$450**
Actual Net Revenue	**$450**	**$450**

- Status quo when unit remains offline: All DA profit is used and balancing revenues (buy back) are excluded.
  - Net revenue of $5,000 is used to offset BOR if unit runs for PJM in other hours when actual net revenue was only $450.
- Proposal when unit remains offline: Include balancing revenues (buy back) and LOC credit.
  - Net revenue of $450 is used to offset BOR if unit runs for PJM in other hours.

Example – Self Schedule Profit (Option A)

	Status Quo Offline	Proposal Offline	Self Sched. Step 2	Option A Step 1
DA LMP ($/MWh)	50	50	50	50
DA Generation (MWh)	100	100	100	100
RT LMP ($/MWh)	100	100	100	100
RT Generation (MWh)	0	0	150	150
Commitment Status	Offline	Offline	Self	Self
Day-Ahead				
DA Revenues	$5,000	$5,000	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750	$2,750	$2,750
DA No Load Cost	$800	$800	$800	$800
DA Start Cost	$1,000	$1,000	$1,000	$1,000
DA Net Revenue	$450	$450	$450	$450
Real-Time / Balancing				
Balancing Revenues	($10,000)	($10,000)	$5,000	$5,000
LOC Credit (A)	$5,000	$5,000	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450	$6,450	$6,450
LOC Credit	$5,450	$5,450	$0	$0
RT Incremental Offer	$0	$0	$5,500	$5,500
RT No Load Cost	$0	$0	$800	$800
RT Start Cost	$0	$0	$1,000	$1,000
Net Revenue Used in BOR	**$5,000**	**$450**	**$2,700**	**$2,700**
Actual Net Revenue	**$450**	**$450**	**$2,700**	**$2,700**

- Option A when unit self-schedules : Floor net revenues during self scheduled hour at zero.
- In this case, step 1 and step 2 result in the same outcome because the unit profited (the floor is not applied).
  - Net revenue of $2,700 is used to offset BOR if unit runs for PJM in other hours.
- The additional profit ($2,700 from self-scheduling vs $450 if remained offline) would be used to offset possible losses in other hours.

Example – Self Schedule Profit (Option B)

	Status Quo	Proposal	Self Sched.	Option A	Option B
	Offline	Offline	Step 2	Step 1	Step 1
DA LMP ($/MWh)	50	50	50	50	50
DA Generation (MWh)	100	100	100	100	100
RT LMP ($/MWh)	100	100	100	100	100
RT Generation (MWh)	0	0	150	150	150
Commitment Status	Offline	Offline	Self	Self	Self
Day-Ahead					
DA Revenues	$5,000	$5,000	$5,000	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750	$2,750	$2,750	$2,750
DA No Load Cost	$800	$800	$800	$800	$800
DA Start Cost	$1,000	$1,000	$1,000	$1,000	$1,000
DA Net Revenue	$450	$450	$450	$450	$450
Real-Time / Balancing					
Balancing Revenues	($10,000)	($10,000)	$5,000	$5,000	($10,000)
LOC Credit (A)	$5,000	$5,000	$5,000	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450	$6,450	$6,450	$6,450
LOC Credit	$5,450	$5,450	$0	$0	$6,450
RT Incremental Offer	$0	$0	$5,500	$5,500	$5,500
RT No Load Cost	$0	$0	$800	$800	$800
RT Start Cost	$0	$0	$1,000	$1,000	$1,000
Net Revenue Used in BOR	**$5,000**	**$450**	**$2,700**	**$2,700**	**$1,450**
Actual Net Revenue	**$450**	**$450**	**$2,700**	**$2,700**	**$2,700**

- Option B when unit self schedules: Balancing revenues and LOC assume the unit is offline.
- In this case, step 1 is less than step 2.
  - Net revenue of $1,450 is used to offset BOR if unit runs for PJM in other hours in step 1.
  - Net revenue of $2,700 is used to offset BOR if unit runs for PJM in other hours in step 2.

Example – Self Schedule Loss

	Status Quo Offline	Proposal Offline
DA LMP ($/MWh)	50	50
DA Generation (MWh)	100	100
RT LMP ($/MWh)	100	100
RT Generation (MWh)	0	0
Commitment Status	Offline	Offline
Day-Ahead		
DA Revenues	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750
DA No Load Cost	$800	$800
DA Start Cost	$1,000	$1,000
DA Net Revenue	$450	$450
Real-Time / Balancing		
Balancing Revenues	($10,000)	($10,000)
LOC Credit (A)	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450
LOC Credit	$5,450	$5,450
RT Incremental Offer	$0	$0
RT No Load Cost	$0	$0
RT Start Cost	$0	$0
Net Revenue Used in BOR	**$5,000**	**$450**
Actual Net Revenue	**$450**	**$450**

- Status quo when unit remains offline: All DA profit is used and balancing revenues (buy back) are excluded.
  - Net revenue of $5,000 is used in BOR to offset unit runs for PJM in other hours.
- Proposal when unit remains offline: Include balancing revenues (buy back) and LOC credit.
  - Net revenue of $450 is used to offset BOR if unit runs for PJM in other hours.

Example – Self Schedule Loss (Option A)

	Status Quo Offline	Proposal Offline	Self Sched. Step 2	Option A Step 1
DA LMP ($/MWh)	50	50	50	50
DA Generation (MWh)	100	100	100	100
RT LMP ($/MWh)	100	100	100	100
RT Generation (MWh)	0	0	50	50
Commitment Status	Offline	Offline	Self	Self
Day-Ahead				
DA Revenues	$5,000	$5,000	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750	$2,750	$2,750
DA No Load Cost	$800	$800	$800	$800
DA Start Cost	$1,000	$1,000	$1,000	$1,000
DA Net Revenue	$450	$450	$450	$450
Real-Time / Balancing				
Balancing Revenues	($10,000)	($10,000)	($5,000)	($5,000)
LOC Credit (A)	$5,000	$5,000	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450	$6,450	$6,450
LOC Credit	$5,450	$5,450	$0	$0
RT Incremental Offer	$0	$0	$1,250	$1,250
RT No Load Cost	$0	$0	$800	$800
RT Start Cost	$0	$0	$1,000	$1,000
Net Revenue Used in BOR	**$5,000**	**$450**	**($3,050)**	**$0**
Actual Net Revenue	**$450**	**$450**	**($3,050)**	**($3,050)**

- Option A when unit self schedules: Floor net revenues during self scheduled hour at zero.
- In this case, step 1 is higher than step 2 because the floor is applied.
  - No net revenues are used to offset BOR if unit runs for PJM in other hours in step 1.
  - Net revenue of -$3,050 is used to offset BOR if unit runs for PJM in other hours in step 2.
- The losses incurred eliminate the expected profit of $450.

Example – Self Schedule Loss (Option B)

	Status Quo	Proposal	Self Sched.	Option A	Option B
	Offline	Offline	Step 2	Step 1	Step 1
DA LMP ($/MWh)	50	50	50	50	50
DA Generation (MWh)	100	100	100	100	100
RT LMP ($/MWh)	100	100	100	100	100
RT Generation (MWh)	0	0	50	50	50
Commitment Status	Offline	Offline	Self	Self	Self
Day-Ahead					
DA Revenues	$5,000	$5,000	$5,000	$5,000	$5,000
DA Incremental Offer	$2,750	$2,750	$2,750	$2,750	$2,750
DA No Load Cost	$800	$800	$800	$800	$800
DA Start Cost	$1,000	$1,000	$1,000	$1,000	$250
DA Net Revenue	$450	$450	$450	$450	$1,200
Real-Time / Balancing					
Balancing Revenues	($10,000)	($10,000)	($5,000)	($5,000)	($10,000)
LOC Credit (A)	$5,000	$5,000	$5,000	$5,000	$5,000
LOC Credit (B)	$5,450	$5,450	$6,450	$6,450	$6,450
LOC Credit	$5,450	$5,450	$0	$0	$6,450
RT Incremental Offer	$0	$0	$1,250	$1,250	$1,250
RT No Load Cost	$0	$0	$800	$800	$800
RT Start Cost	$0	$0	$1,000	$1,000	$1,000
Net Revenue Used in BOR	**$5,000**	**$450**	**($3,050)**	**$0**	**$1,450**
Actual Net Revenue	**$450**	**$450**	**($3,050)**	**($3,050)**	**($3,050)**

- Option B when unit self schedules: Balancing revenues and LOC assume unit is offline.
- In this case, step 1 is more than step 2.
  - Net revenue of $1,450 is used to offset BOR if unit runs for PJM in other hours in step 1.
  - Net revenue of -$3,050 is used to offset BOR if unit runs for PJM in other hours in step 2.

Summary

Option A

- Floor at zero the net revenues during self schedule intervals.
- In Step 1, incremental profits or losses from the decision to self-schedule are combined with expected DA net revenues that LOC guarantees or with net revenues during pool scheduled intervals.

Option B

- Treat self schedule hours as offline.
- Balancing revenues will reflect 0 MW in RT.
- LOC will be calculated.
- In Step 1, incremental profit / losses earned from the decision to self-schedule are not included in the Step 1 BOR credit calculation.

Conclusion

- **Status quo considerably overstates net revenues received when units are offline ($5,000 vs $450 in examples).**
- **Proposal of starting eligibility with the first DA award hour incorporates balancing revenues and LOC credits. Net revenues will be accurate.**
- **Self scheduling needs to be addressed.**
  - **Both options presented represent an improvement over status quo where the full DA net revenue and none of the balancing revenue is used in self scheduled intervals.**

Self Scheduling Options

- **Self scheduling requires special treatment:**
  - **Option B results in DA net revenues, compared to option A it results in more uplift when self scheduling results in additional profits.**
  - **Option B results in DA net revenues, compared to Option A, it results in less uplift when self scheduling results in a loss.**
- **The IMM and PJM prefer Option B.**
  - **Treating the resource in Step 1 is more consistent with the concept of Step 1 representing the outcome of following PJM instructions (including not coming online).**
  - **With this option, the self scheduling decision does not impact the level of uplift payments**
    - Additional profits made while self scheduling are not used in BOR credits.
    - Additional losses incurred due to self scheduling are not made whole via BOR credits.

Treatment of LOC Ineligible Flexible Resources

- **Offline Flexible Resources become ineligible to receive LOC credits when:**
  - **Min run time or time to start increase beyond 2 hours.**
  - **Become unavailable.**
- **If an offline Flexible Resource that was committed DA by PJM and is deemed ineligible for LOC credits per the rules in Manual 28, any buy back in excess of the DA revenue will not be made whole and is the responsibility of the market participant. This is consistent with the status quo since, under these conditions, Flexible Resources currently are not made whole for intervals where they are offline.**

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