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IESO Technical Panel

Adjustments to Real-Time Make-Whole Payments: Examples, Vote to Post: Follow-Up on Feedback

Independent Electricity System Operator (IESO)

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Supplementary Examples to Address Feedback

- This deck provides examples that addresses detailed questions received from a Panel member.
- Also includes two minor adjustments to the market rules language that was previously posted on the TP webpage:
  - The first adjustment is a clarification to the rule wording based on comments received.
  - The second is a revision that came out of edge-case testing conducted by the team.
- These adjustments will be included in the amendment package.

Overview

Item	Description
1	Lost Opportunity Cost (LOC) and Forbidden Regions
2	Operating Reserve (OR) Ramping in LOC EOP Calculations
3	Make-Whole Payment (MWP) Not Offsetting Amongst Energy and OR Products

Item 1 Update

- Vlad Urukov, Technical Panel member from OPG, indicated that in MR Ch.9 s.3.5.6.3:
  - There is no set of conditions that make it clear what forbidden region assumptions are to be used for RT_OR_FROP_LOC, the way there are clear “where….” conditions for RT_FROP_LC and RT_FROP_LOC
  - Absent a modification, it is not clear if section 3.5.6.3 is to use the set of assumptions for 3.5.6.1 or 3.5.6.2 which are different in regards to UL and LL’s "equal to" portion

Item 1 Update (cont'd)

- To resolve this ambiguity, IESO proposes the following changes to MR Ch.9 s.3.5.6.3 (in red):
- This ensures the rules are clear and that the same assumption for the energy FROP LOC applies to the OR FROP LOC as well.

$$RT\_OR\_FROP\_LOC_{r.k.h}^{m,t} = Max[0, OP(RT\_PROR_{r.h}^{m,t}, (RT\_OR\_LOC\_EOP_{r.k.h}^{m,t} - QTY\_ADJ_{r.k.h}^{m,t}), BOR_{r.k.h}^{m,t})] - Max\left(0, OP(RT\_PROR_{r.h}^{m,t}, RT\_QSOR_{r,k,h}^{m,t}, BOR_{r,k,h}^{m,t})\right)$$

Where:

a. $QTY\_ADJ_{r.k.h}^{m,t} = \text{Max}(0, QTY\_DIFF_{r.k.h}^{m,t} - FR\_QTY\_AVAIL_{r.k.h}^{m,t})$

b. $QTY\_DIFF_{r.k.h}^{m,t} = RT\_OR\_LOC\_EOP_{r.k.h}^{m,t} - RT\_QSOR_{r.k.h}^{m,t}$

c. For synchronized *ten-minute operating reserve*:

$$FR\_QTY\_AVAIL_{r1,k,h}^{m,t} = Max\left[0, Max\left(DAM\_QSI_{k,h}^{m}, Min(RT\_QSI_{k,h}^{m,t}, AQEI_{k,h}^{m,t})\right) - Max(FR\_LL_{k,h}^{m,f}, DAM\_QSI_{k,h}^{m}, RT\_LC\_EOP_{k,h}^{m,t})\right]$$

Where:

i. '$FR\_LL_{k}^{m,f}$' is the *forbidden region* lower limit from *forbidden region* set 'f' where $RT\_QSI_{k.h}^{m,t} >= FR\_LL_{k}^{m,f}$, as submitted by *market participant* 'k' for *delivery point* 'm' as daily *dispatch data*.

ii. 'f' = (1...N) of the *forbidden region* set {$FR\_UL_{k}^{m,f}$, $FR\_LL_{k}^{m,f}$} and 'N' is the maximum number of *forbidden regions* submitted by *market participant* 'k' for *delivery point* 'm' as daily *dispatch data*.

Item 3 Update

- While reviewing the market rule changes for item 3, an edge case scenario with unintended outcomes was identified.
- The market rules impacted are in Chapter 9 sections 3.5.4.5 & 3.5.4.6.
- The LC scenario that is not being handled correctly is when the resource is scheduled in RT above their RT EOP and their injections or withdrawals are less than the RT EOP.
- The LOC scenario that is not being handled correctly is when the resource is scheduled in RT below their RT EOP and their injections or withdrawals are greater than the RT EOP.
- These situations can occur when a resource is deviating from dispatch, and their deviation is across multiple laminations.

Item 3 Update (cont'd)

- An incremental adjustment to the market rules (shown in yellow highlight) will address this scenario; the existing language of "it is injecting or withdrawing energy" which was deleted in the previous draft language has been added back:

3.5.4.5 *resources* shall be ineligible for positive ELC when it is injecting or withdrawing *energy* below its RT_LC_EOP or when its *real-time schedule* for *energy* is less than its RT_LC_EOP;

3.5.4.6 *resources* shall be ineligible for positive ELOC when it is injecting or withdrawing *energy* above its RT_LOC_EOP or when its *real-time schedule* for *energy* is greater than its RT_LOC_EOP;

Item 3 Example 1 LC:

RT Schedule

105 MW

LC EOP Schedule

100 MW

LOC EOP Schedule

100 MW

Energy RT LMP

$45/MWh

Injections

85 MW

DAM_QSI = 0MW

P	Q
$20	0
$20	50
$25	80
$40	90
$45	100
$70	120

RT Lost Cost Calculation		
	OP (Min(RT_QSI, AQEI))	OP (RT_LC_EOP)
Revenue	85MW X $45 = $3,825	100MW X $45 = $4,500
Costs	50MW X $20 + 30MW X $25 + 5MW X $40 =	50MW X $20 + 30MW X $25 + 10MW X $40 + 10MW X $45=
	$1,950	$2,600
Net	$3,825 - $1950 = $1,875	$4,500 - $2,600 = $1,900
RT_ELC	-1 X ($1,875 - $1,900) = $25 / 12 = $2.08	

The $2.08 is unwarranted because it is incentivizing the resource to not follow dispatch. The resource is not incurring a loss that would warrant a RT MWP.

Item 3: Proposed LOC Eligibility Criteria for Each Product

LOC EOP vs. Dispatch Schedule	Sign of LOC MWP	LOC Eligibility
EOP > Dispatch Schedule	Positive	Y
EOP > Dispatch Schedule	Negative	Y
EOP < Dispatch Schedule	Positive	N
EOP < Dispatch Schedule	Negative	Y

Item 3: Current LC Eligibility Criteria for Each Product

LC EOP vs. Dispatch Schedule	Sign of LC MWP	LC Eligibility
EOP > Dispatch Schedule	Positive	N
EOP > Dispatch Schedule	Negative	Y
EOP < Dispatch Schedule	Positive	Y
EOP < Dispatch Schedule	Negative	Y

Item 3: Revised LC Eligibility Criteria for Each Product

LC EOP vs. Dispatch Schedule	LC EOP vs. Measurements	Sign of LC MWP	LC Eligibility
EOP > Dispatch Schedule	EOP > Measurement	Positive	N
EOP > Dispatch Schedule	EOP > Measurement	Negative	Y
EOP < Dispatch Schedule	EOP < Measurement	Positive	Y
EOP < Dispatch Schedule	EOP < Measurement	Negative	Y
EOP > Dispatch Schedule	EOP < Measurement	Positive	N
EOP > Dispatch Schedule	EOP < Measurement	Negative	Y
EOP < Dispatch Schedule	EOP >Measurement	Positive	N
EOP < Dispatch Schedule	EOP > Measurement	Negative	Y

New scenario being addressed

Item 1 Additional Example 1: Forbidden Region

Forbidden Region 1	Max Capacity
0 MW – 20 MW	40 MW

Dispatch Schedule

Energy	10S
0 MW	0 MW

EOP Schedule

Energy	10S
0 MW	40 MW

Energy LMP	Energy Offer PQ1	Energy Offer PQ2
$5/MWh	20MW @ $1	40MW @ $19

10S LMP	10S Offer
$10/MWh	40MW @ $1

RT Lost Cost Calculation		
	OP (Min(RT_QSI, AQEI))	OP (RT_LC_EOP)
Revenue	0MW X $5 = $0	0MW X $5 = $0
Costs	$0	0
	$0	$0
Net	0	0
RT_ELC	0	

RT OR Lost Opportunity Cost Calculation		
	OP (RT_QSOR)	OP (RT_OR_LOC_EOP)
Revenue	0MW X $10 = $0	40MW X $10 = $400
Costs	0	40MW X $1 =
	$0	$40
Net	0	$400 - $40 = $360
RT_OLOC	($360-$0) = $360 / 12 = $30	

Item 1 Additional Example 1: Forbidden Region (con't)

- RT MWP for the lost opportunity operating reserve will be paid.
- the resource is not being scheduled in energy at within or at the upper limit of the forbidden region
- since no energy lost cost is being triggered, no FROP clawback will apply to the operating reserve
- Chapter 9 section 3.5.6.1

Where:

a. the *dispatchable generation resource* is registered as a hydroelectric *generation resource,* $RT\_QSI_{k,h}^{m,t}$ is greater than $FR\_LL_{k}^{m,f}$, and $RT\_QSI_{k,h}^{m,t}$ is less than or equal to $FR\_UL_{k}^{m,f}$, then:

$$RT\_FROP\_LC_{k,h}^{m,t} = OP\left(RT\_LMP_{h}^{m,t}, Max\left(DAM\_QSI_{k,h}^{m}, Min(RT\_QSI_{k,h}^{m,t}, AQEI_{k,h}^{m,t}), BE_{k,h}^{m,t}\right)\right) - OP\left(RT\_LMP_{h}^{m,t}, Max(FR\_LL_{k,h}^{m,f}, DAM\_QSI_{k,h}^{m}, RT\_LC\_EOP_{k,h}^{m,t}), BE_{k,h}^{m,t}\right)$$

Item 1 Additional Example 2: Forbidden Region

Forbidden Region 1	Max Capacity
0 MW – 20 MW	40 MW

Dispatch Schedule

Energy	10S
20 MW	20 MW

EOP Schedule

Energy	10S
0 MW	40MW

Energy LMP	Energy Offer PQ1	Energy Offer PQ2
$5/MWh	20MW @ $1	40MW @ $19

10S LMP	10S Offer
$10/MWh	40MW @ $1

RT Lost Cost Calculation		
	OP (Min(RT_QSI, AQEI))	OP (RT_LC_EOP)
Revenue	20MW X $5 = $100	0
Costs	20MW X $1 = $20	0 $0
Net	$100 - $20 = $80	0
RT_ELC	-1 X ($80 - $0) = -$80 / 12 = -$6.67	

RT OR Lost Opportunity Cost Calculation		
	OP (RT_QSOR)	OP (RT_OR_LOC_EOP)
Revenue	20MW X $10 = $200	40MW X $10 = $400
Costs	20MW X $1 = $20	40MW X $1 = $40
Net	$200 - $20 = $180	$400 - $40 = $360
RT_OLOC	($360-$180) = $180 / 12 = $15	

Item 1 Additional Example 2: Forbidden Region (con't)

- RT MWP for the lost opportunity operating reserve will be clawed back because the RT energy schedule is at the upper boundary of the forbidden region
- Therefore, a FROP clawback will apply to OR lost opportunity for the same amount of MW as the energy lost cost
- Net RT MWP in this example will be $0

Item 1 Additional Example 3: Forbidden Region

Forbidden Region 1	Max Capacity
0 MW – 20 MW	40 MW

Dispatch Schedule

Energy	10S
0 MW	40 MW

EOP Schedule

Energy	10S
0 MW	40MW

Energy LMP	Energy Offer PQ1	Energy Offer PQ2
$5/MWh	20MW @ $1	40MW @ $19

10S LMP	10S Offer
$10/MWh	40MW @ $1

RT Lost Cost Calculation		
	OP (Min(RT_QSI, AQEI))	OP (RT_LC_EOP)
Revenue	0MW X $5 = $0	0MW X $5 = $0
Costs	$0	0
	$0	$0
Net	0	0
RT_ELC	0	

RT OR Lost Opportunity Cost Calculation		
	OP (RT_QSOR)	OP (RT_OR_LOC_EOP)
Revenue	40MW X $10 = $400	40MW X $10 = $400
Costs	40MW X $1 = $40	40MW X $1 = $40
Net	$400 - $40 = $360	$400 - $40 = $360
RT_OLOC	($360-$360) = $0	

Item 1 Additional Example 3: Forbidden Region (con't)

- Since there are no differences between the DSO schedules and the EOP schedules, no RT MWP will be triggered.
- Net RT MWP in this example will be $0