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Market Renewal – Energy Project Implementation Market Settlements

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Webinar Participation

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Agenda

1. Updates to market settlement documents

- Market Manuals 5.6, 5.7, 5.8 and 5.10
- Charge Types and Equations

2. Implementation Design Modifications

- Corrections to DAM Balancing Credit formulas to align with design intent
- Modify Intertie Failure Charges to address potential gaming issues
- Align ORA with MRP design



Updates to Market Settlement documents

Updates to Market Settlement Documents

- Market Manual 5.6: Non-Market Settlement Program
 - Repurposed market manual 5.6: Physical Market Settlement Invoicing
 - Relocated all legislation, regulation and ministry programs from current market manual 5.5 (no significant changes to the content)
 - Minor clarification – e.g. tables to display charges, formatting changes
- Market Manual 5.7: Settlement Process & Market Manual 5.8: Settlement Invoicing
 - Added day-ahead market to section 2.1

Updates to Market Settlement Documents

- Market Manual 5.10: Settlement Disagreements
 - Clarify data submission for NOD to include new data set for MRP (no change to submission process)
- IESO Charge Types and Equations
 - Added new sections – Active and Inactive Charges
 - Removed variables related to IESO administered-market. These are included in Appendix 9.2: Data Inputs and Variables
 - Added rounding convention for new MRP charges
- Summary of changes can be found in the Readers Guide on the IESO website



Implementation Design Modifications



Correction to Day-Ahead Balancing Credit Formula to align with design intent

DAM Balancing Credit (DAM_BC) - Recap

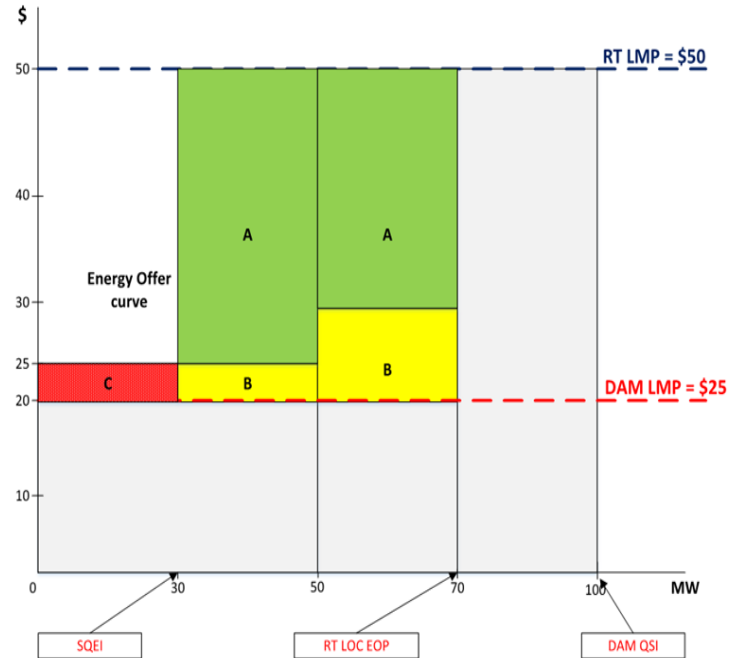
- Offsets negative buyback/sellback incurred as a result of following IESO dispatch instructions issued for reliability reasons
- Applied in RT when the IESO curtails imports and exports, or de-commits GOG-eligible resources after it receives a DAM schedule
- A resource will not be eligible for a DAM Balancing Credit payment for the following key reasons:
 - it does not follow dispatch instructions
 - it was constrained on at the request of a market participant to prevent endangering the safety of any person, equipment damage, or violation of any applicable law (SEAL)
 - it received a RT_MWP for the same interval

Issues Identified with Boundary Entity Current Formula

- As currently formulated, the following scenarios would result in the DAM BC being reduced by the amount of energy or operating reserve scheduled in RT:
 - When an import is dispatched down, and the real-time offer prices are increased
 - When an export is dispatched down, and the real-time bid prices are decreased
- This does not align with the intent of DAM BC to offset any negative buyback as a result of following IESO reliability based dispatch instructions, and the IESO is proposing to update the formulation to resolve this

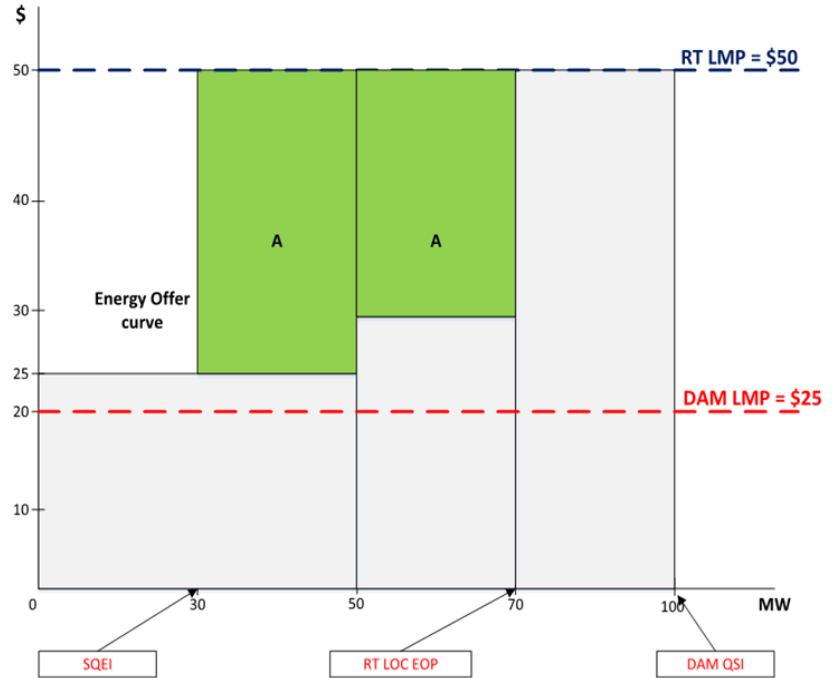
Issue with the Current Formula

- **Scenario 1:** An import is dispatched down to 30 MW
- The intent of the current formula was to calculate (area A – area B), but the current formula was also subtracting area C



Correction of Current formula

- The revised formula will achieve the desired intent by calculating the DAM BC in two operating profit equations resulting in only area A



Changes to Imports Energy Formula

- Current Formula:

$$BCE_{k,h}^i = \text{Max} \left[0, \sum^T (\text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSI_{k,h}^i) - SQEI_{k,h}^i) \times (RT_LMP_h^{i,t} - DAM_LMP_h^{i,t}) + OP(DAM_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSI_{k,h}^i), BE_{k,h}^{i,t}) \right] / 12$$

- Revised Formula:

$$BCE_{k,h}^i = \text{Max} \{ 0, \sum^T OP(RT_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSI_{k,h}^i), BE_{k,h}^{i,t}) - OP(RT_LMP_h^{i,t}, SQEI_{k,h}^{i,t}, BE_{k,h}^{i,t}) \}$$

Changes to Exports Energy Formula

- Current Formula:

$$BCE_{k,h}^i = \text{Max} \left[0, \sum^T (\text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSW_{k,h}^i) - SQEW_{k,h}^i) \right. \\ \left. \times (DAM_LMP_h^{i,t} - RT_LMP_h^{i,t}) \right. \\ \left. - OP(DAM_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSW_{k,h}^i), BL_{k,h}^{i,t}) \right] / 12$$

- Revised Formula:

$$BCE_{k,h}^i = -1 \times \text{Min} \left\{ 0, \sum^T OP(RT_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSW_{k,h}^i), BL_{k,h}^{i,t}) \right. \\ \left. - OP(RT_LMP_h^{i,t}, SQEW_{k,h}^i, BL_{k,h}^{i,t}) \right\}$$

Changes to OR Formula for Boundary Entities

- Current Formula:

$$\begin{aligned}
 & BCOR_{k,h}^i \\
 &= \sum_{\square}^R \text{Max} \left[0, \sum_{\square}^T (\text{Min}(RT_OR_LOC_EOP_{r,k,h}^{i,t}, DAM_QSOR_{r,k,h}^i) \right. \\
 &\quad \left. - RT_QSOR_{r,k,h}^i) \times (RT_PROR_{r,h}^{i,t} - DAM_PROR_h^{i,t}) \right. \\
 &\quad \left. + OP(DAM_PROR_{r,h}^{i,t}, \text{Min}(RT_OR_LOC_EOP_{r,k,h}^{i,t}, DAM_QSOR_{r,k,h}^i), BOR_{r,k,h}^{i,t}) \right] / 12
 \end{aligned}$$

- Revised Formula:

$$\begin{aligned}
 & DAM_BCOR_{k,h}^i \\
 &= \sum^R \text{MAX} \{ 0, \sum^T OP(RT_PROR_{r,h}^{i,t}, \text{Min}(RT_OR_LOC_EOP_{r,k,h}^{i,t}, DAM_QSOR_{r,k,h}^i), BOR_{r,k,h}^{i,t}) \\
 &\quad - OP(RT_PROR_{r,h}^{i,t}, RT_QSOR_{r,k,h}^{i,t}, BOR_{r,k,h}^{i,t}) \} / 12
 \end{aligned}$$

New Eligibility Rules for Boundary Entities

- Similar to energy transactions, a boundary entity is not eligible for DAM BC for operating reserve when:
 - DAM PROR is equal to or greater than RT PROR
 - $\text{Min}(\text{RT_OR_LOC_EOP}, \text{DAM_QSOR})$ is equal to or less than RT_QSOR
- This aligns with the intent of the DAM BC to only provide compensation when the IESO curtails operating reserves relative to its DAM position



Modify Intertie Failure Charges to address potential gaming issues

Recap of Intertie Failure Charge

- Discourages market participants from failing transactions by applying a financial charge
- Only MWs that are incremental to DAM schedules are subject to this failure charge
- It is applicable to import and export transactions that failed for reasons within their control*

*see MM 4.3 for intertie coding of bona fide and legitimate reasons

Issues Identified

- Pre-dispatch results are used to determine RT prices hence traders may have information of the potential RT intertie price prior to transaction flowing in real-time
- This may provide financial incentive to purposely fail the transactions scheduled in DA and PD when it is advantageous to do so
- As a result of failed transactions, additional costs related to congestion and NISL are incurred and are currently charged back to Ontario consumers instead of the market participant responsible for the failed transaction
- Disincentives market participants from offering/bidding their marginal cost, resulting in higher congestion and NISL prices in general

Proposed Change – RT Intertie Failure Charge

Solution

Real-time intertie failure charge will be modified such that:

- The market participant will be charged with the impact to the intertie border price for the failed MWs and also be subject to their impact on the RT external congestion and RT NISL

Failed MW = portion of the pre-dispatch schedule that is greater than the DAM schedule and is not scheduled in real time

Rationale

- Charging the transaction with external congestion and NISL is consistent with the practice of other jurisdictions, with market surveillance panel (MSP) recommendation*, and also with the IESO's current compliance assessment practice
- Any shortfall in congestion and NISL caused by these failed transactions are charged back to the market participant responsible for the failed transaction instead of Ontario consumers through an uplift

*MSP Report for the period November 2015-April 2016

RT-Import Failure Charge (RT_IMFC) – Proposed Change:

RT Failed Import:

$$RT_ISD_{k,h}^{i,t} = \text{MAX}(PD_QSI_{k,h}^i - \text{MAX}(DAM_QSI_{k,h}^i, SQEI_{k,h}^{i,t}), 0)$$

**Equation for RT_ISD has been simplified.*

RT Import Failure Charge:

$$\begin{aligned} &RT_IMFC_{k,h}^i \\ &= \sum^T [(-1) \\ &\times \text{MIN}(\text{MAX}(0, (RT_IBP_h^{i,t} + PB_IM_h^t - PD_IBP_h^i) \times RT_ISD_{k,h}^{i,t}), \\ &\text{MAX}(0, RT_IBP_h^{i,t} \times RT_ISD_{k,h}^{i,t})) + \text{MIN}(0, (RT_PEC_h^{i,t} + RT_NISL_h^{i,t}) \times RT_ISD_{k,h}^{i,t})] / 12 \end{aligned}$$

'PB_IM_h^t' is the price bias adjustment factor for import transactions in effect during metering interval 't' of settlement hour 'h'.

RT-Export Failure Charge (RT_EXFC) – Proposed Change:

RT Failed Export:

$$RT_ESD_{k,h}^{i,t} = \text{MAX}(PD_QSW_{k,h}^i - \text{MAX}(DAM_QSW_{k,h}^i, SQEW_{k,h}^{i,t}), 0)$$

RT Export Failure Charge:

$$\begin{aligned} & RT_EXFC_{k,h}^i \\ &= \sum^T \left[(-1) \right. \\ & \times \text{MIN} \left(\text{MAX} \left(0, (PD_IBP_h^i - PB_EX_h^t - RT_IBP_h^{i,t}) \times RT_ESD_{k,h}^{i,t} \right), \text{MAX} \left(0, PD_IBP_h^i \times RT_ESD_{k,h}^{i,t} \right) \right) \\ & \left. - \text{MAX} \left(0, (RT_PEC_h^{i,t} + RT_NISL_h^{i,t}) \times RT_ESD_{k,h}^{i,t} \right) \right] / 12 \end{aligned}$$

$PB_EX_h^t$

is the price bias adjustment factor for export transactions in effect during metering interval 't' of settlement hour 'h'

Proposed Solution – DAM Intertie Failure Charge (NEW)

Solution

New DAM intertie failure charge will apply to an intertie transaction such that:

- DAM failed MWs will be charged with the RT external congestion and RT NISL
- DAM Failed MW = portion of DAM MW that is scheduled in pre-dispatch and is not scheduled in real-time

Rationale

- Remove the incentive to fail transaction on purpose
- Any revenues shortfall caused by the failed transactions are charged back to the participant instead of Ontario consumers
- Encourages market participants to offer/bid their marginal cost, resulting in lower congestion and NISL prices in general

DAM-Import Failure Charge (DAM_IMFC) – Formula (NEW):

DAM Failed Imports:

$$DAM_ISD_{k,h}^{i,t} = \text{MAX}(\text{MIN}(DAM_QSI_{k,h}^i, PD_QSI_{k,h}^i) - SQEI_{k,h}^{i,t}, 0)$$

Import Failure Charge:

$$DAM_IMFC_{k,h}^i = \sum^T \text{MIN}(0, (RT_PEC_h^{i,t} + RT_NISL_h^{i,t}) \times DAM_ISD_{k,h}^{i,t} / 12)$$

DAM-Export Failure Charge (DAM_EXFC) – Formula (NEW):

DAM Failed Export:

$$DAM_ESD_{k,h}^{i,t} = \text{MAX}(\text{MIN}(DAM_QSW_{k,h}^i, PD_QSW_{k,h}^i) - SQEW_{k,h}^{i,t}, 0)$$

DAM Export Failure Charge:

$$DAM_EXFC_{k,h}^i = \sum^T (-1) \times \text{MAX}(0, (RT_PEC_h^{i,t} + RT_NISL_h^{i,t}) \times DAM_ESD_{k,h}^{i,t} / 12)$$



Align ORA with MRP Design

Background: OR Standby Payment Claw-back

- The current OR Standby Payment Claw-back is intended to ensure the IESO receives OR service that it procured.
- MRP will maintain the principles of the current OR Standby Payment Claw-back which are:
 - It is not triggered by OR activation but by the difference between scheduled OR and total accessible OR
 - Specifically targets OR that is inaccessible to the IESO
 - MPs may still be subjected to compliance assessment for failure to provide the activated OR.

Operating Reserve Claw-backs - Recap

- OR Standby Payments will be adjusted based on OR that cannot be accessed
- Total Accessible OR for all classes will be calculated as follows:
 - For generators – difference between a resource's output and its maximum capability
 - For Loads – allocated quantity of energy withdrawn (AQEW)
- Total accessible OR will be counted towards the OR provider scheduled quantity in the order 10-minute spinning (10S), 10-minute non-spinning (10N) and 30-minute non-spinning (30R)
- Total inaccessible OR is calculated as the difference between total OR scheduled for all classes and total accessible OR

MRP Implementation Proposal for ORA

Three settlement claw-back modifications are being proposed by MRP to align the principles of the ORA with MRP:

- OR Standby Payment Claw-back for dispatchable generator and loads (**revision to current rules**)
- RT MWP claw-back for the portion of OR that was inaccessible (**New**)
- RT GOG claw-back for the portion of OR that was inaccessible (**New**)

Proposed Changes to OR Standby Payment Claw-backs

- **For dispatchable load resources:**
 - Modification to the existing formulas to settle based on RT locational marginal price for operating reserve instead of 5-minutes MCP
- **For generation resources:**
 - Modification to the existing formulas to settle based on RT locational marginal price for operating reserve instead of 5-minutes MCP for non-aggregated generation resources
 - The settlement of aggregated generation resources (PSU and non-PSU resources) will be modified to handle differences in price at each aggregated resource.
- No change to the eligibility rules for dispatchable generation and load resources

OR Standby Payment Claw-back – Aggregated Dispatchable Generator (non-PSU)

Steps for calculating Aggregated Dispatchable Generator OR Standby Payment Claw-back are as follows:

1. Determine total accessible OR for each generation resource
2. Determine for each generation resource Inaccessible OR for each class of OR
3. Determine for each generator, Total OR provided
- 4. Determine excess available headroom (new)**
- 5. Reallocate any excess headroom (new)**
- 6. Determine the Net Operating reserve deviation (new)**
7. Determine Total OR Claw-back and pro-rate claw-back amount to all aggregated generation resources based on the amount of their inaccessible OR

Sample Calculation – Aggregated Generator

Scenario 1: An aggregated generator receives OR schedule for all 3 types of OR and has inaccessible OR in HE 16

Input data:

	Gen A	Gen B	Gen C
	MWs	MWs	MWs
Max_CAP	160	160	160
AQEI	120	120	130
AQOR _{r1} (10S)	0	0	90
AQOR _{r2} (10N)	0	26	0
AQOR _{r3} (30R)	26	0	0

Sample Calculation – Aggregated Generator

Step 1: Determine total accessible operating reserve (TAOR) for each type of OR

$$\text{TAOR} = \text{Max}(0, \text{Max_CAP} - \text{AQEI})$$

	MaxCap	AQEI	TAOR
	MWs	MWs	MWs
Gen A	160	120	40
Gen B	160	120	40
Gen C	160	130	30

$\sum_R \text{AQOR} > \text{TAOR}$ for Gen C; therefore OR Standby Payment claw-back will be assessed.

Sample Calculation – Aggregated Generator

Step 2: Determine Inaccessible OR (ORIA) for each class of OR

$$ORIA_{r1} = \text{Min} (0, \text{TAOR} - \text{AQOR}_{r1})$$

$$ORIA_{r2} = \text{Min} [0, (\text{Max} (0, \text{TAOR} - \text{AQOR}_{r1}) - \text{AQOR}_{r2})]$$

$$ORIA_{r3} = \text{Min} [0, (\text{Max}(0, \text{TAOR} - \text{AQOR}_{r1} - \text{AQOR}_{r2}) - \text{AQOR}_{r3})]$$

	OR Schedule (AQOR)			TAOR	Inaccessible OR (ORIA)		
	10S	10N	30R		10S	10N	30R
Gen A	0	0	26	40	0	0	0
Gen B	0	26	0	40	0	0	0
Gen C	90	0	0	30	-60	0	0

Sample Calculation – Aggregated Generator

Step 3 & 4 : Determine Total OR provided (ORP) and the Excess Available Headroom (EAH) by each generation resource.

$$ORP_{r1} = \text{Min} (AQOR_{r1}, TAOR)$$

$$ORP_{r2} = \text{Min} [AQOR_{r2}, (\text{Max} (0, TAOR - AQOR_{r1}))]$$

$$ORP_{r3} = \text{Min} [AQOR_{r3}, (\text{Max} (0, TAOR - AQOR_{r1} - AQOR_{r2}))]$$

	OR Schedule (AQOR)			TAOR	OR Provided (ORP)			Excess Available Headroom (EAH)
	10S	10N	30R		10S	10N	30R	
Gen A	0	0	26	40	0	0	26	14
Gen B	0	26	0	40	0	26	0	14
Gen C	90	0	0	30	30	0	0	0

$$EAH = \text{Max} (0, TAOR - \sum_R AQOR)$$

Sample Calculation – Aggregated Generator

Step 5 : Reallocate any Excess Available Headroom

	Excess Available Headroom (EAH)	Inaccessible OR (ORIA)			Reallocated Excess Headroom (REAH)		
		10S	10N	30R	10S	10N	30R
		Gen A	14	0	0	0	14
Gen B	14	0	0	0	14	0	0
Gen C	0	-60	0	0	0	0	0

TREAH is allocated to each generation resource in proportion to their EAH.

When $\sum^M EAH > 0$, we will calculate the total excess available headroom that is available for reallocation (TREAH) using the following formulas:

$$\text{If } \sum_{r1,k,h}^M ORIA_{r1,k,h}^{m,t} < 0, \text{ then } TREAH_{r1,k,h}^{M,t} = \text{Min}(\sum_{k,h}^M EAH_{k,h}^{m,t}, (-1) \times \sum_{r1,k,h}^M ORIA_{r1,k,h}^{m,t})$$

$$\text{If } \sum_{r2,k,h}^M ORIA_{r2,k,h}^{m,t} < 0, \text{ then } TREAH_{r2,k,h}^{M,t} = \text{Min}[(\sum_{k,h}^M EAH_{k,h}^{m,t}) - TREAH_{r1,k,h}^{M,t}, (-1) \times \sum_{r2,k,h}^M ORIA_{r2,k,h}^{m,t}]$$

$$\text{If } \sum_{r3,k,h}^M ORIA_{r3,k,h}^{m,t} < 0, \text{ then } TREAH_{r3,k,h}^{M,t} = \text{Min}[(\sum_{k,h}^M EAH_{k,h}^{m,t}) - TREAH_{r1,k,h}^{M,t} - TREAH_{r2,k,h}^{M,t}, (-1) \times \sum_{r3,k,h}^M ORIA_{r3,k,h}^{m,t}]$$

In this scenario, inaccessible OR is -60 MW at 10S, therefore $TREAH_{10S} = 28$ MWs

Sample Calculation – Aggregated Generator

Step 7 : Determine Net Operating deviation

	OR Schedule (AQOR)			OR Provided (ORP)			Reallocate Excess Headroom (REAH)			Net Operating Reserve Deviation (NORD)		
	10S	10N	30R	10S	10N	30R	10S	10N	30R	10S	10N	30R
Gen A	0	0	26	0	0	26	14	0	0	14	0	0
Gen B	0	26	0	0	26	0	14	0	0	14	0	0
Gen C	90	0	0	30	0	0	0	0	0	-60	0	0

$$\text{NORD} = \text{ORP} + \text{REAH} - \text{AQOR}$$

Sample Calculation – Aggregated Generator

Step 8 : Calculate total OR standby payment claw-back amount and the proration to each generation resource

	Net Operating Reserve Deviation			OR Price			OR Claw-back (ORSCB)		
	10S	10N	30R	10S	10N	30R	10S	10N	30R
Gen A	14	0	0	\$30	\$20	\$10	\$420	\$0	\$0
Gen B	14	0	0	\$28	\$18	\$8	\$392	\$0	\$0
Gen C	-60	0	0	\$32	\$22	\$12	(\$1,920)	\$0	\$0

Total OR clawback =	(\$1,108)
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The total OR standby payment claw-back is pro-rated to each generation resource as follows:

$$ORSCB_m = ORSCB_M \times \frac{\sum_R ORIA_r}{\sum_{R,M} ORIA_r}$$

Gen C was the only resource with inaccessible OR of -60 MW therefore it will receive the full charge of \$1,108

OR Standby Payment Claw-back – Aggregated Dispatchable Generator (PSU)

- For PSU resources, the methodology defined for non-PSU will be used to calculate PSU, however, the total accessible OR (TAOR) will be determined as follows:
- **For CT** : $TAOR = \text{Max}(0, \text{Max_Cap} - \text{AQEI})$ when $\text{AQEI} \geq \text{MLP}$, otherwise $TAOR = 0$
- **For ST**: $TAOR = \text{Max}\left[0, \left(\sum_D^{P1} \text{ORRQ}_{k,d}^p\right) - \left(\sum_{C1} \text{MAX_CAP}_{k,h}^{c,t}\right) - \text{AQEI}_{k,h}^{s,t}\right]$
 - ❖ P1 is the set of all PSU associated with ST such that CT $\text{AQEI} \geq \text{MLP}$ and the CT or ST is not in single cycle mode
 - ❖ C1 is the combustion turbine resource $\geq \text{MLP}$ and not in single cycle mode
 - ❖ D is the operating range regions: MLP, dispatchable and duct-firing

OR Standby Payment Claw-back – Charge Codes

- OR standby payment claw-back will continue to be settled under the existing charges:
 - CT 206 : 10-Minute spinning Non-Accessibility Settlement Amount
 - CT 208 : 10-Minute non-spinning Non-Accessibility Settlement Amount
 - CT 210 : 30-Minute Non-Accessibility Settlement Amount

MRP Implementation Proposal of RT MWP and RT GOG Claw-backs

- RT MWP and RT GOG payments will be adjusted for the amount of operating reserve that was not accessible to IESO to avoid overpayments
- The lost cost and lost opportunity cost for operating reserve will be adjusted for the total accessible operating reserve (TAOR) in order of operating reserve class
- New RT MWP and RT GOG claw-back settlement charges will be created to settle these clawed-back amounts
- The existing RT MWP and RT GOG settlement equations and charge codes will remain unchanged

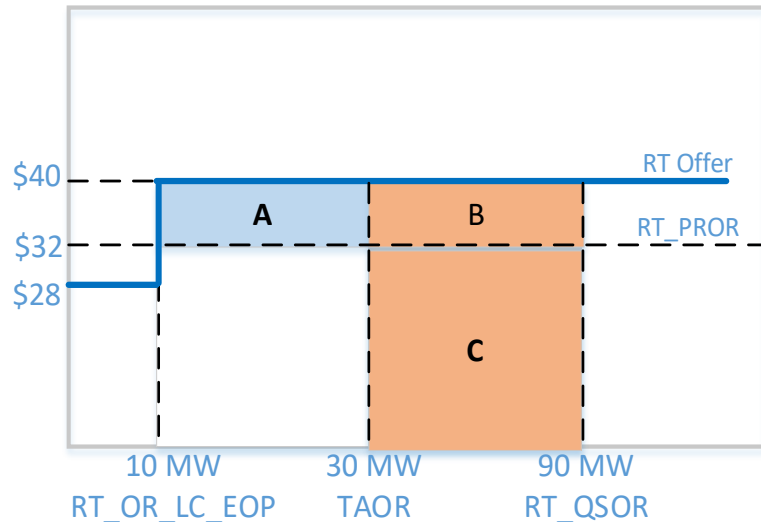
RT MWP Claw-Back – Lost Cost Formulas

The formulas for calculating the adjustment of lost cost MWP for inaccessible operating reserve is defined as follows:

- **OLC_CB_{r1}** = [OP(Max(DAM_QSOR_{r1}, RT_QSOR_{r1})) – OP(Max(TAOR, RT_OR_LC_EOP_{r1}, DAM_QSOR_{r1}))]
- **OLC_CB_{r2}** = [OP(Max(DAM_QSOR_{r2}, RT_QSOR_{r2})) – OP(Max(TAOR – RT_QSOR_{r1}, RT_OR_LC_EOP, DAM_QSOR_{r2}))]
- **OLC_CB_{r3}** = [OP(Max(DAM_QSOR_{r3}, RT_QSOR_{r3})) – OP(Max(TAOR – RT_QSOR_{r1} – RT_QSOR_{r2}, RT_OR_LC_EOP, DAM_QSOR_{r3}))]

RT MWP Claw-back – Lost Cost Example

Scenario 1: Generator A is scheduled 10S operating reserve and $RT_SQOR > TAOR$



- The resource was not scheduled in DAM

RT Lost Cost Reversal		
	$OP(\text{Max}(\text{DAM_QSOR}_{r1}, \text{RT_QSOR}_{r1}))$	$OP(\text{Max}(\text{TAOR}, \text{RT_OR_LC_EOP}_{r1}, \text{DAM_QSOR}_{r1}))$
Revenue	$90\text{MW} \times \$32 =$ \$2880	$30\text{MW} \times \$32 =$ \$960
Costs	$10\text{MW} \times \$28 +$ $80\text{MW} \times \$40 =$ \$3480	$10\text{MW} \times \$28 +$ $20\text{MW} \times \$40 =$ \$1080
Net	$\$2880 - 3480 =$ -\$600	$\$960 - 1080 =$ -\$120
RT_ELCRC	$-\\$600 - (-\\$120) = -\\$480$	

Generator A would be charged a RT MWP claw-back of \$480

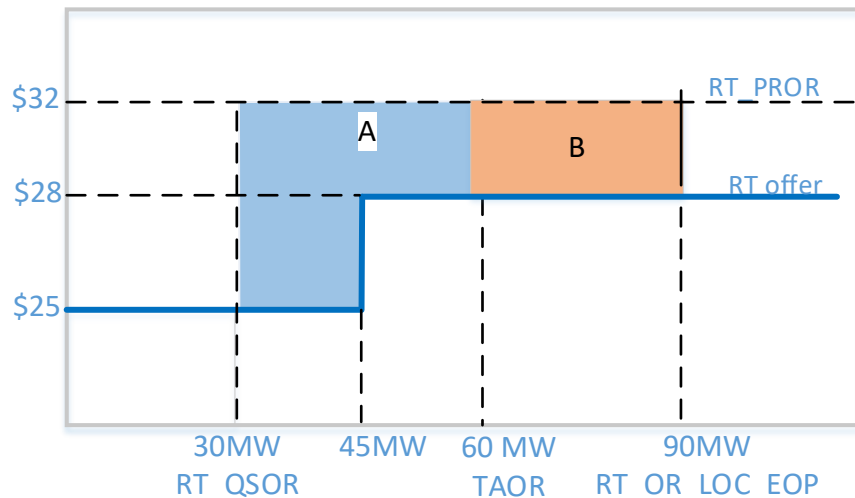
RT MWP Claw-back – Lost Opportunity Cost Formulas

The formulas for calculating the adjustment of lost opportunity cost MWP for inaccessible operating reserve is defined as follows:

- $OLOC_CB_{r_1} = -1 \times [OP(RT_OR_LOC_EOP) - OP(\text{Max}(RT_QSOR_{r_1}, TAOR))]$
- $OLOC_CB_{r_2} = -1 \times [OP(RT_OR_LOC_EOP) - OP(\text{Max}(RT_QSOR_{r_2}, TAOR - RT_QSOR_{r_1}))]$
- $OLOC_CB_{r_3} = -1 \times [OP(RT_OR_LOC_EOP) - OP(\text{Max}(RT_QSOR_{r_3}, TAOR - RT_QSOR_{r_1} - RT_QSOR_{r_2}))]$

RT MWP Claw-back – Lost Opportunity Cost Example

Scenario 2: Generator B is scheduled 10S operating reserve and $RT_SQOR < TAOR$



RT Lost Opportunity Cost Reversal		
	$OP(\text{Max}(\text{RT_OR_LOC_EOP}_{r1}))$	$OP(\text{Max}(\text{RT_QSOR}_{r1}, \text{TAOR}))$
Revenue	$90\text{MW} \times \$32 =$	$60\text{MW} \times \$32 =$
	\$2880	\$1920
Costs	$45\text{MW} \times \$25 + 45\text{MW} \times \$28 =$	$45\text{MW} \times \$25 + 15\text{MW} \times \$28 =$
	\$2385	\$1545
Net	$\$2880 - 2385 =$	$\$1920 - 1545 =$
	\$495	\$375
RT_ELCRC	$-1 \times (495 - 375) = -\120	

Generator B would be charged a RT MWP claw-back of \$120

MRP Proposal for RT GOG Claw-back

In the event that a resource is determined to have inaccessible OR, two issues arise:

- The true quantity of *operating reserve* supplied is less than RT_QSOR; the current RT_GOG equation will compensate the market participant for losses that it did not actually incur
- The market participant may be assessed an OR Standby Payment Claw-back, which should be counted as negative revenue in the RT_GOG equation
- To address the issue, RT GOG payments will be clawed-back for inaccessible OR

MRP Proposal for RT GOG Claw-back

- RT GOG claw-back is limited to Component 2 of the RT GOG which calculates the shortfall in payments for operating reserves
- RT GOG claw-back will comprise 4 terms:
 1. **Term 1:** Reversal of OR Standby Payment Claw-back – this accounts for the negative revenue associated with OR Standby Payment Claw-back (ORSCB_REV)
 2. **Term 2:** Operating profit or loss incurred on quantities between TAOR and operating reserve schedule (COMP2_CB)
 3. **Term 3:** Revenue earned on quantity that was scheduled but not accessible (ORIA_AMT)
 4. **Term 4:** RT MWP Claw-back

RT GOG Claw-back – Non-Aggregated Generators Formulas

RT GOG will be calculated as:

$$RT_GOG_CB = \sum_R^{T1} (ORSCB_REV + COMP2_CB - ORIA_AMT)$$

T1 is the set of all metering intervals 't' in the real-time commitment period

Where: **Term 1:** ORCSCB_REV = (-1) x ORSCB

Term 2: COMP2_CB is calculated as:

For 10S (r1): OP(RT_QSOR_{r1}) – OP(TAOR)

For 10N (r2): OP(RT_QSOR_{r2}) – OP(TAOR - RT_QSOR_{r1})

For 30R (r3): OP(RT_QSOR_{r3}) – OP(TAOR - RT_QSOR_{r1} - RT_QSOR_{r2})

Term 3: ORIA_AMT is calculated as:

For 10S (r1): RT_PROR_{r1} x (RT_QSOR_{r1} - TAOR)

For 10N (r2): RT_PROR_{r2} x (RT_QSOR_{r2} - TAOR - RT_QSOR_{r1})

For 30R (r3): RT_PROR_{r3} x (RT_QSOR_{r3} - TAOR - RT_QSOR_{r1} - RT_QSOR_{r2})

RT GOG Claw-back - Pseudo-Unit Formulas

For **CT**: The calculation of Term 1, 2 & 3 are the same as that of a non-PSU generator.

For **ST**: RT GOG Clawback is calculated as follows:

$$RT_GOG_CB_k^s = \sum_{\square}^{T1} \left[ORSCB_REV_{k,h}^{s,t} + \sum_R (COMP2_CB_{r,k,h}^{s,t} - ORIA_AMT_{k,h}^{s,t}) \right]$$

Where 'T1' is the set of all metering intervals 't' in the ST real-time commitment period where at least one of the associated PSU is greater than or equal to its MLP

RT GOG Claw-back - Pseudo-Unit Formulas

$$\mathbf{OCSCB_REV} = -1 \times ORSCB_{k,h}^{s,t} \times \frac{\sum_R OR_RT_GOG_DIGQ_{r,k,h}^{s,t}}{\sum_R RT_QSOR_{r,k,h}^{s,t}},$$

this is necessary to reduce ORSCB negative charge based on the ST available performance due to the number of PSU operating in combined cycle

Term 2 & 3, the calculation is same as non PSU except TAOR will be substituted for TAOR ST

$$TAOR_ST = TAOR_ST_{k,h}^{s,t} \times \frac{\sum_R OR_RT_GOG_DIGQ_{r,k,h}^{s,t}}{\sum_R RT_QSOR_{r,k,h}^{s,t}},$$

this is necessary to reduce the proportion of ST available headroom based on the number of PSUs operating in combined cycle

Next Steps:

September 29 : Comments/feedback on IESO Charge type and equation due to IESO

October 20 : Comments/feedback on implementation design modification due to IESO

Q1 2024 : Updates to relevant documents will be circulated for stakeholder review

Thank You

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Appendix A

Scenario 1: An import energy is curtailed in RT

Inputs:

RT Energy Offers – Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	50
3	30	70
4	50	100

Schedules, EOP, LMP		
Type	Quantity	Units
SQEI	30	MW
RT LOC EOP	70	MW
DAM QSI	100	MW
RT LMP	50	\$
DAM LMP	20	\$

This Import transaction is eligible for the DAM BC:

- RT LMP > DAM LMP
- DAM QSI > SQEI

Scenario 1: An import energy is curtailed in RT

$$BCE_{k,h}^i = \text{Max}\{0, \sum^T OP(RT_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSI_{k,h}^i), BE_{k,h}^{i,t}) - OP(RT_LMP_h^{i,t}, SQEI_{k,h}^{i,t}, BE_{k,h}^{i,t})\}$$

Operating Profit at DAM schedule or RT LOC EOP:

OP (RT_LMP, MIN(DAM_QSI, RT_LOC_EOP), BE)

Revenue = 70 MW x 50 = \$3500

Cost = (50MW x \$25) + (20MW x \$30) = \$1850

Net Amount = (\$3500 - \$1850) = \$1650

Scenario 1: An import energy curtailed in RT

Operating Profit at RT Schedule (SQEI):

OP (RT_LMP, SQEI, BE)

$$\text{Revenue} = 30 \text{ MW} \times 50 = \$1500$$

$$\text{Cost} = (30\text{MW} \times \$25) = \$750$$

$$\text{Net Amount} = (\$1500 - \$750) = \$750$$

$$\text{BCE} = \text{Max}(0, \$1650 - \$750) = \$900$$

Export DAM BC: Scenario 2

Inputs:

RT Energy Offers – Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	10	0
2	10	70
3	5	100
4	2	120

Schedules, EOP, LMP		
Type	Quantity	Units
SQEW	30	MW
RT LOC EOP	70	MW
DAM QSI	100	MW
RT LMP	6	\$
DAM LMP	15	\$

This Export transaction is eligible for the DAM BC:

- RT LMP < DAM LMP
- DAM QSI > SQEI

Export DAM BC: Scenario 2

$$BCE_{k,h}^i = -1 \times \text{Min}\{0, \sum^T OP(RT_LMP_h^{i,t}, \text{Min}(RT_LOC_EOP_{k,h}^{i,t}, DAM_QSW_{k,h}^i), BL_{k,h}^{i,t}) - OP(RT_LMP_h^{i,t}, SQEW_{k,h}^{i,t}, BL_{k,h}^{i,t})\}$$

Operating Profit at DAM schedule or RT LOC EOP:

OP (RT_LMP, MIN(DAM_QSW, RT_LOC_EOP), BL)

Cost = 70 MW x \$6 = \$420

Bid Cost = (70MW x \$10) = \$700

Net Amount = (\$420 - \$700) = -\$380

Export DAM BC: Scenario 2

Operating Profit at RT Schedule (SQEW):

OP (RT_LMP, SQEW, BE)

$$\text{Cost} = 30 \text{ MW} \times \$6 = \$180$$

$$\text{Bid Cost} = 30 \text{ MW} \times \$10 = \$300$$

$$\text{Net Amount} = (\$180 - \$300) = -\$120$$

$$\text{BCE} = -1 * \text{Min}(0, -\$380 - (-\$120)) = \$260$$

Export DAM BC: Scenario 2

Operating Profit at RT Schedule (SQEI):

OP (RT_LMP, SQEI, BE)

$$\text{Revenue} = 30 \text{ MW} \times 50 = \$1500$$

$$\text{Cost} = (30\text{MW} \times \$25) = \$750$$

$$\text{Net Amount} = (\$1500 - \$750) = \$750$$

$$\text{BCE} = \$1650 - \$750 = \$900$$