



FEBRUARY 15, 2022

Market Renewal – Energy Project Implementation – Market Rules Market Power Mitigation

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Agenda

1. Reference level process and scenarios
2. Constrained areas scenarios
3. Ex-post mitigation for intertie withholding scenarios
4. Calculation engine background and scenarios
5. Ex-ante mitigation for economic withholding scenarios
6. Ex-post mitigate for physical withholding scenarios

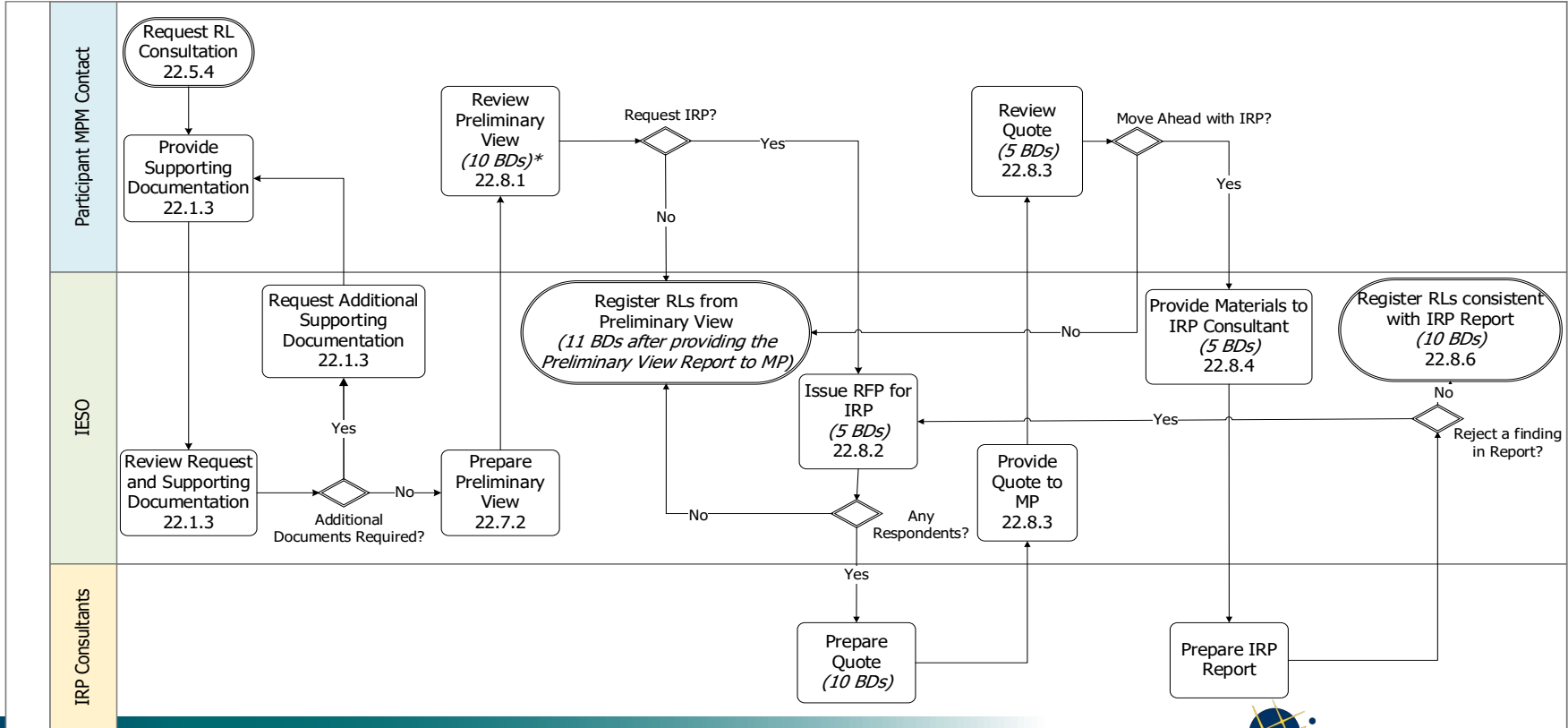


Reference Level Process and Scenarios

Reference Level Process: Update

- The IESO re-examined section 22.2.3 in response to the comments that it attracted at the January TP meeting
- Section 22.2.3 is not necessary given the process for establishing reference levels and has been removed
- Section 22.2.3 allowed the IESO to determine a \$0 reference level if a market participant failed to provide required information or supporting documentation

Reference Level Process



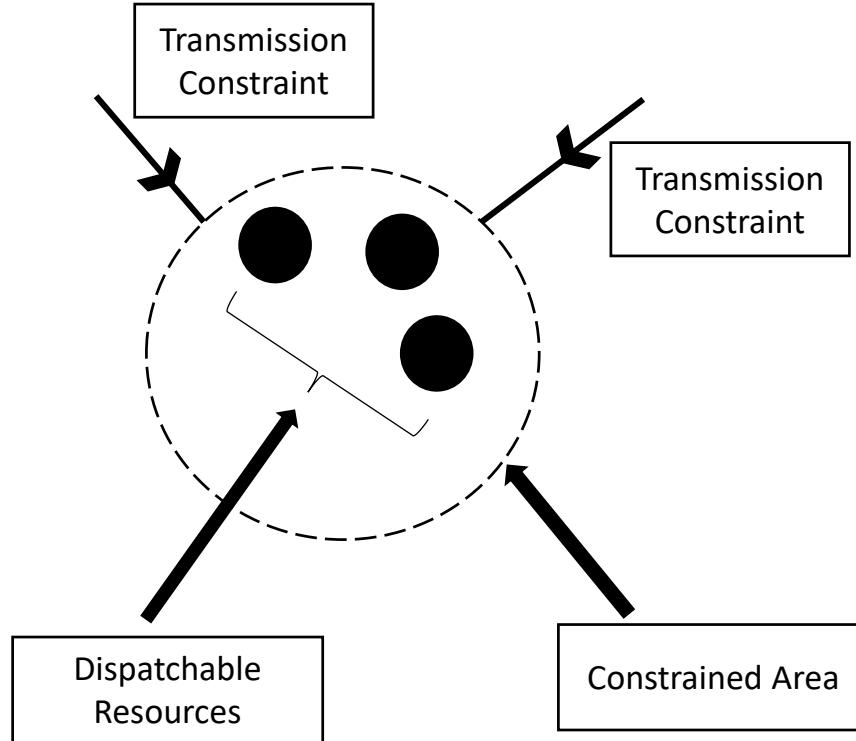
Reference Level Process

- The Technical Panel requested information identifying any remedies available to market participants with regards to IESO decisions related to market power mitigation
- The notice of dispute process applies generally and will continue to be available to market participants in the renewed market
- The notice of disagreement process is also available where market participants identify mistakes in their settlement statements

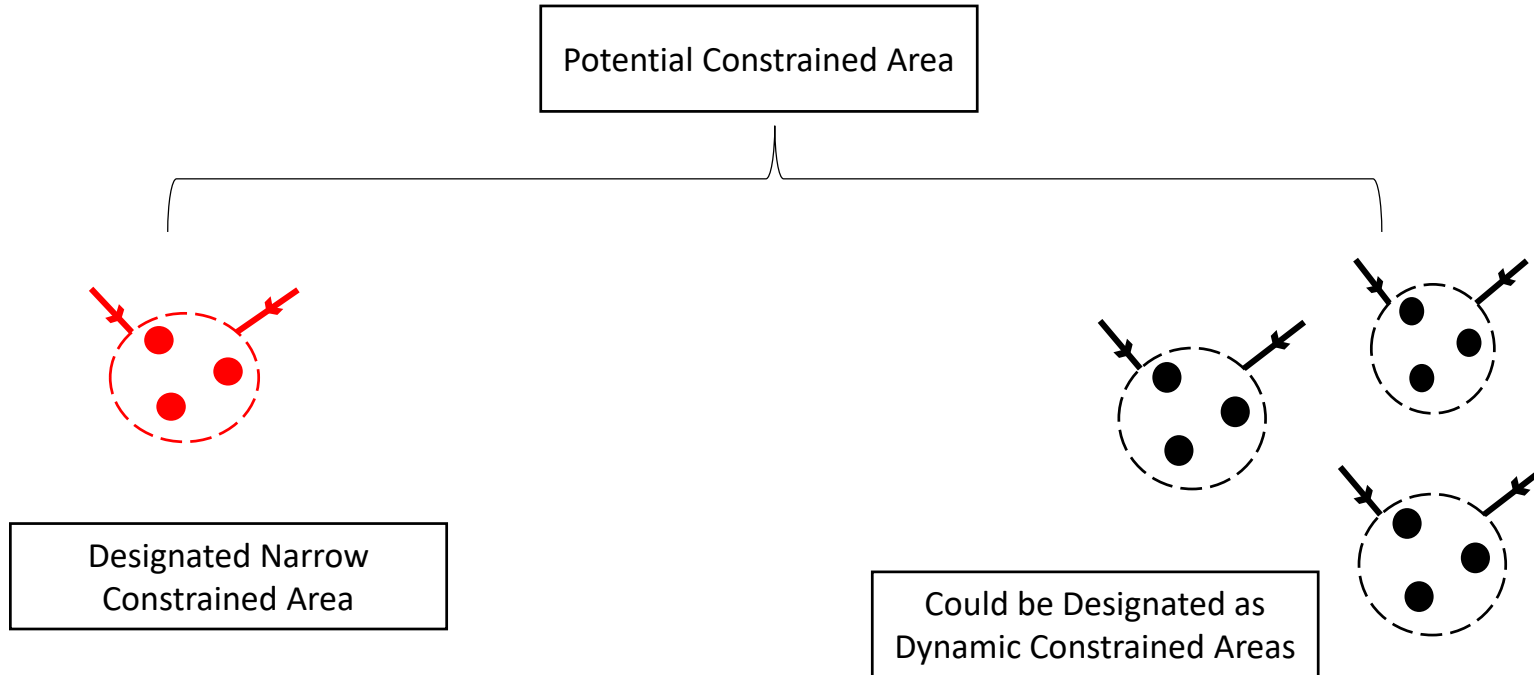


Constrained Areas Scenarios

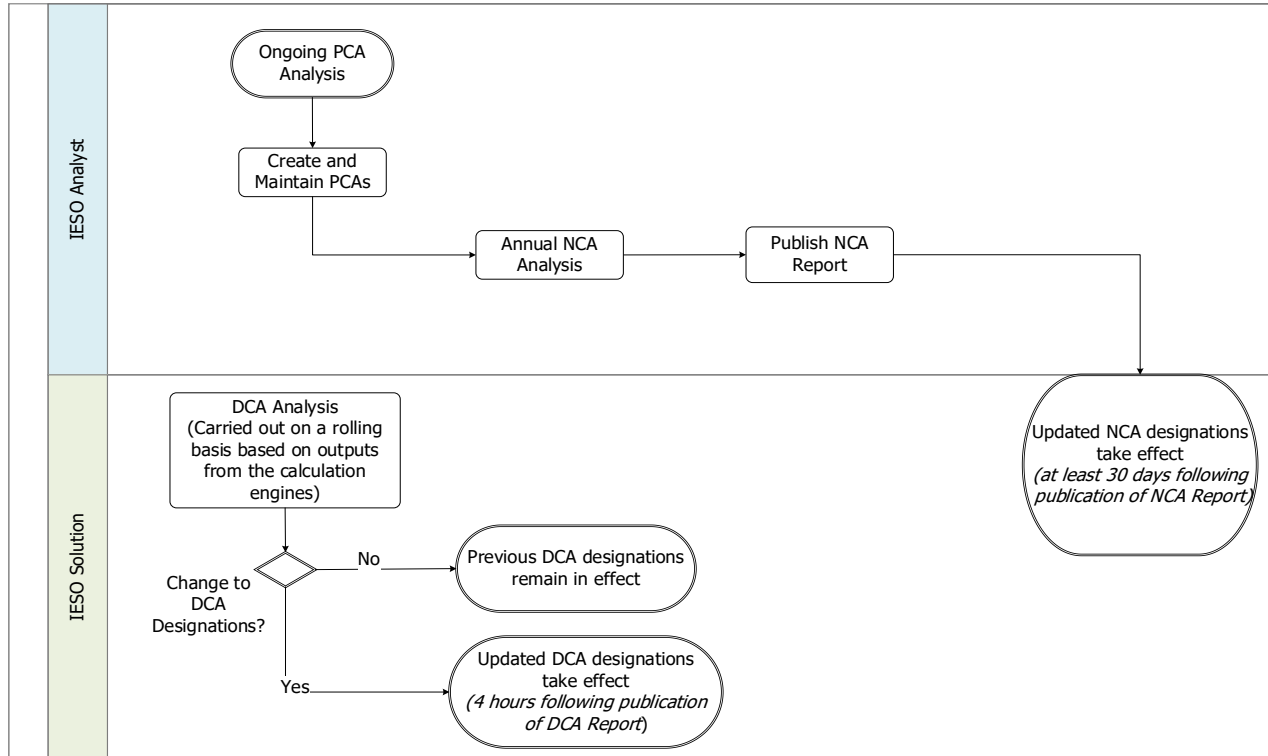
Constrained Areas: Background



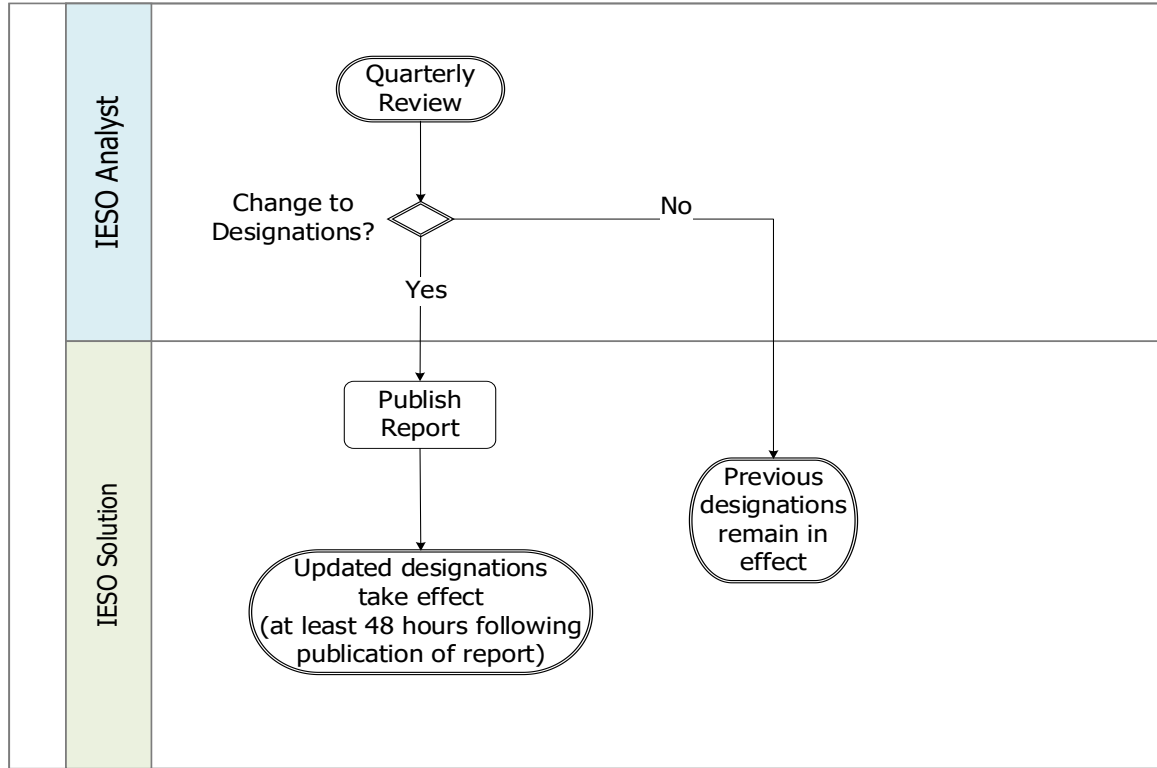
Constrained Areas: Background



Constrained Areas: Designation of NCAs and DCAs



Constrained Areas: Uncompetitive Intertie Designation



Intertie Withholding – Import – Energy

Determination of the Intertie Reference Level

- See spreadsheet for the determination of the Intertie Reference Level
- Importer offers energy at the same price every day: \$150
- Intertie Reference Level = \$150

Intertie Withholding – Import – Energy

Resource Information	
Resource Name	IZA.IMPORT.ONT.SOURCE.01
Import or Export	Import
Uncompetitive Intertie Zone	Intertie Zone A

Energy LMP
500

Constrained Area Type and Applicable Test Threshold	
Constrained area	Uncompetitive Intertie Zone
Conduct test threshold	Energy IRL + MIN(300% of Energy IRL, \$100/MWh)
Impact test threshold	IRL run Energy LMP + MIN (\$50/MWh, 100% of IRL run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	500	0
2	500	100

Import Offer Reference Level for Energy		
PQ #	Price (\$/MWh)	Quantity (MW)
1	150	0
2	150	100

Intertie Withholding – Import – Energy

Conduct Test	
Lamination	0-100 MW
Offer Price	\$500/MW
Is the conduct test carried out?	Yes
Conduct test threshold	$\$150 + \$100 = \$250/\text{MW}$
Conduct test outcome	Fail
MWHs Failed	100 MWhs

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Intertie Reference Level
Simulated Energy LMP from as-offered run	\$500/MWh
Simulated Energy LMP from reference level run	\$150/MWh
Impact test threshold	$\$150 + \$50 = \$200/\text{MWh}$
Impact test outcome	Fail

Intertie Withholding – Import – Energy

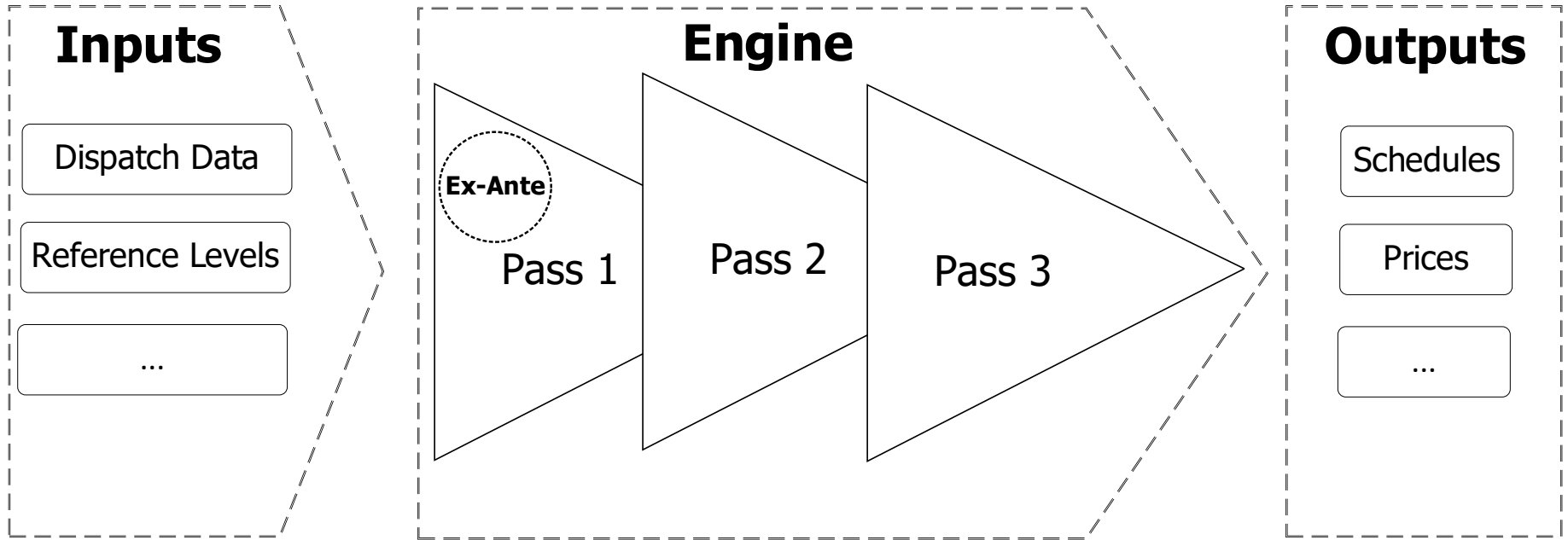
Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	100
Energy LMP	\$500
Settlement charge appearing on 1st notice	\$50,000

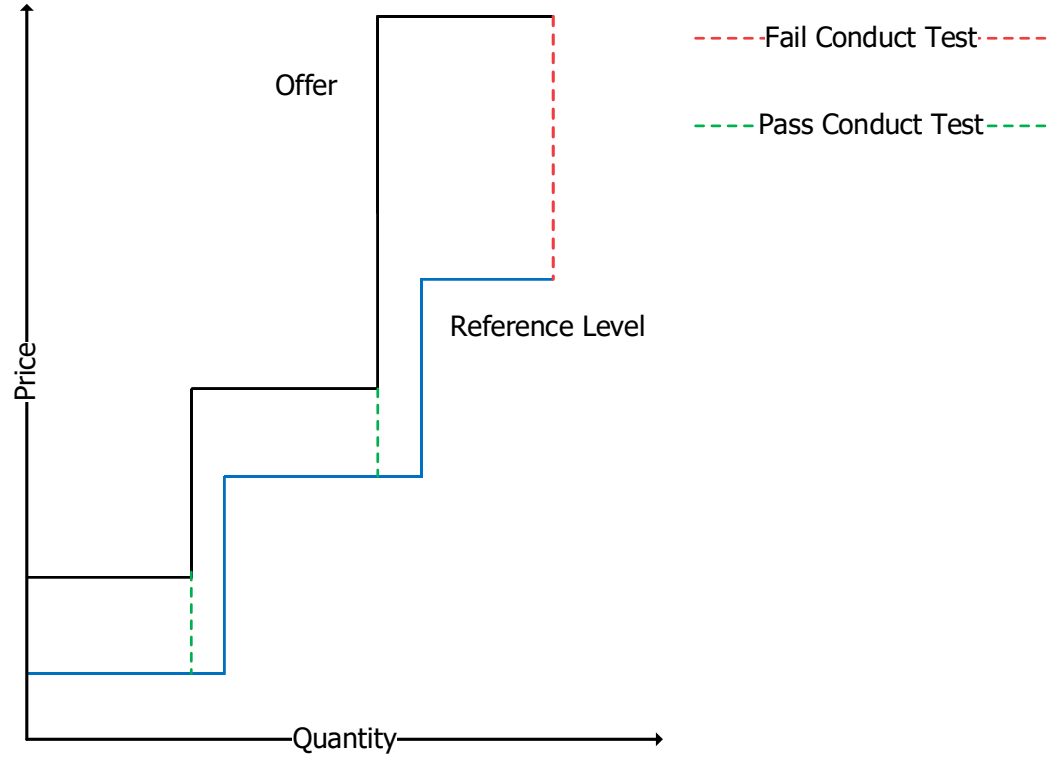


Calculation Engine Background and Scenarios

Calculation Engine Background: DAM Ex-Ante Mitigation



Calculation Engine Background: Ex-Ante Conduct Tests



Calculation Engine Background: Joint Optimization

- Technical Panel members requested that the IESO speak to how mitigation could impact jointly optimized market outcomes for economic and physical withholding
- Simulation to determine actual outcomes is not possible, however it is possible to make some directional observations
- Joint optimization aims to satisfy energy and operating reserve requirements at the same time
- Conceptually speaking, the price of energy is the change in total system cost associated with satisfying an incremental MW of energy demand and the price of operating reserve is the corollary

Calculation Engine Background: Joint Optimization

- Mitigation, when it is applied, will reduce the offer prices for energy and operating reserve
- All else being equal, this will make the supply of those products from a particular resource relatively cheaper
- Whether a resource is scheduled to provide energy or operating reserve is an output of the calculation engine given all the inputs for a particular run
- It is not possible to make predictive statements about specific outcomes

Calculation Engine Background: Joint Optimization

- A resource offering energy and operating reserve will be selected based on the cost of supply of these products, relative to all other potential sources of supply
- Market participants that want to provide energy can use very low energy offer prices to make those energy offers more likely to be scheduled in the calculation engines
- Market power mitigation will not replace an offer price below a reference level with the higher reference level. It can only reduce offer prices that are too high



Ex-Ante Mitigation for Economic Withholding Scenarios

Ex-ante Mitigation: Energy – Hydro – BCA

Resource Information	
Technology type of resource	Hydroelectric
Capacity	150 MW

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RL + MIN(300% of Energy RL, \$100/MWh)
Impact test threshold	RL run Energy LMP + MIN (\$50/MWh, 100% of RL run Energy LMP)

Energy Offers – Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	19	0
2	19	50
3	35	75
4	40	120
5	800	150

Energy Offer Reference Level		
PQ #	Price (\$/MWh)	Quantity (MW)
1	5	0
2	5	50
3	15	100
4	45	150

Ex-ante Mitigation: Energy – Hydro – BCA

Conduct Test				
Lamination	0-50 MWh	50.1-75 MWh	75.1-120 MWh	120.1-150 MWh
Offer Price	\$19/MWh	\$35/MWh	\$40/MWh	\$800/MWh
Is the conduct test carried out?	Yes	Yes	Yes	Yes
Conduct test threshold	4*\$5= \$20/MWh	4*\$15= \$60/MWh	\$45 + \$100= \$145/MWh	\$45 + \$100= \$145/MWh
Conduct test outcome	Pass	Pass	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
LMP from as-offered run	\$800/MWh
LMP from reference level run	\$45/MWh
Impact test threshold	\$45 + \$45 = \$90/MWh
Impact test outcome	Fail

Ex-ante Mitigation: Energy – Hydro – BCA

Outcome	Mitigation applied
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Energy Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	5	0
2	5	50
3	15	100
4	45	150

Ex-ante Mitigation: OR – Hydro – Global

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	100 MW

Constrained Area Type and Applicable Test Threshold	
Condition	Global Market Power
Conduct test threshold	10S OR RL + MIN(\$25/MW, 50% of 10S OR RL)
Impact test threshold	RL run 10S OR LMP + MIN(\$25/MW, 50% of RL run 10S OR LMP)

10S Operating Reserve Offers – Dispatch Data		
PQ #	Price (\$/MW)	Quantity (MW)
1	8	0
2	8	50
3	200	100

10S Operating Reserve Offer Reference Level		
PQ #	Price (\$/MW)	Quantity (MW)
1	6	0
2	6	50
3	12	100

Ex-ante Mitigation: OR – Hydro – Global

Conduct Test		
Lamination	0-50 MW	50.1-100 MW
Offer Price	\$8/MW	\$200/MW
Is the conduct test carried out?	Yes	Yes
Conduct test threshold	$\$6 + \$3 = \$9/\text{MW}$	$\$12 + \$6 = \$18/\text{MW}$
Conduct test outcome	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
10S OR LMP from as-offered run	\$200/MW
10S OR LMP from reference level run	\$12/MW
Impact test threshold	$\$12 + \$6 = \$18/\text{MW}$
Impact test outcome	Fail

Ex-ante Mitigation: OR – Hydro – Global

Outcome	Mitigation applied
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10S OR Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	6	0
2	6	50
3	12	100

Ex-ante Mitigation: Energy – Multiple Resources – NCA

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	100 MW

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
MLP	20 MW
Capacity	100 MW

Resource Information	
Resource Name	Wind GS
Technology type of resource	Wind
Capacity	100 MW

Constrained Area Type and Applicable Test Threshold	
Constrained area	NCA
Conduct test threshold	Energy RL + MIN(50% of Energy RL, \$25/MWh)
Impact test threshold	RL run Energy LMP + MIN (\$25/MWh, 50% of RL run Energy LMP)

Ex-ante Mitigation: Energy – Multiple Resources – NCA

Energy Offers - Dispatch Data		
Hydro GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	25
3	50	75
4	250	100

Energy Offer Reference Level		
Hydro GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	25
3	50	75
4	100	100

Energy Offers - Dispatch Data		
Thermal GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	20
3	50	80
4	90	100

Energy Offer Reference Level		
Thermal GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	35	0
2	35	20
3	40	80
4	50	100

Energy Offers - Dispatch Data		
Wind GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	20	0
2	20	50
3	30	100

Energy Offer Reference Level		
Wind GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	26	0
2	26	100

Ex-ante Mitigation: Energy – Multiple Resources – NCA

Conduct Test			
Hydro GS			
Lamination	0-25 MWh	25.1-75 MWh	75.1-100 MWh
Offer Price	\$30/MWh	\$50/MWh	\$250/MWh
Is the conduct test carried out?	Yes	Yes	Yes
Conduct test threshold	$\$25 + \$12.5 = \$37.50/\text{MWh}$	$\$50 + \$25 = \$75/\text{MWh}$	$\$100 + \$25 = \$125/\text{MWh}$
Conduct test outcome	Pass	Pass	Fail

Conduct Test		
Thermal GS		
Lamination	20.1-80 MWh	80.1-100 MWh
Offer Price	\$50/MWh	\$90/MWh
Is the conduct test carried out?	Yes	Yes
Conduct test threshold	$\$40 + \$20 = \$60/\text{MWh}$	$\$50 + \$25 = \$75/\text{MWh}$
Conduct test outcome	Pass	Fail

Conduct Test		
Wind GS		
Lamination	0-50 MWh	50.1-100 MWh
Offer Price	\$20/MWh	\$30/MWh
Is the conduct test carried out?	No	Yes
Conduct test threshold	N/A	$\$26 + \$13 = \$39/\text{MWh}$
Conduct test outcome	N/A	Pass

Ex-ante Mitigation: Energy – Multiple Resources – NCA

Impact Test			
	Hydro GS	Thermal GS	Wind GS
Impact test needed?	Yes	Yes	No
Offer that will be used in RL run	Reference Level	Reference Level	N/A
Energy LMP from as-offered run	\$250/MWh	\$250/MWh	N/A
Energy LMP from reference level run	\$100/MWh	\$100/MWh	N/A
Impact test threshold	$\$100 + \$25 = \$125/\text{MWh}$	$\$100 + \$25 = \$125/\text{MWh}$	N/A
Impact test outcome	Fail	Fail	N/A

Ex-ante Mitigation: Energy – Multiple Resources – NCA

Outcome	Hydro GS	Thermal GS	Wind GS
	Mitigation applied	Mitigation applied	No mitigation applied

Energy Offers after Mitigation		
Hydro GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	25
3	50	75
4	100	100

Energy Offers after Mitigation		
Thermal GS		
PQ #	Price (\$/MWh)	Quantity (MW)
1	35	0
2	35	20
3	40	80
4	50	100



Ex-Post Mitigation for Physical Withholding Scenarios

Ex-Post PW Mitigation: Energy – Hydro – BCA

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	150 MW

Energy LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RQ - MIN(10% of Energy RQ, 100 MW)
Impact test threshold	RQ run Energy LMP + MIN (\$50/MWh, 100% of RQ run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	40	60
4	50	75

Energy Reference Quantity
90

Ex-Post PW Mitigation: Energy – Hydro – BCA

Conduct Test	
Maximum Offer Lamination	75
Is the conduct test carried out?	Yes
Conduct test threshold	$90 - 9 = 81$
Conduct test outcome	Fail
MWhs Failed	15

Impact Test	
Impact test needed?	Yes
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$50 = \$120/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: Energy – Hydro – BCA

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	15
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$[MWhs\ Failed] * [LMP] * [Persistence\ Multiplier] * 1.5$
Settlement charge appearing on 1st notice	\$4,050

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	250 MW

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	150 MW

Resource Information	
Resource Name	Solar GS
Technology type of resource	Solar
Capacity	25 MW

Constrained Area Type and Applicable Test Threshold	
Constrained area	NCA
Constrained area Name	NCA 1
MCE conduct test threshold	Energy RQ - 5 MW
Impact test threshold	RQ run Energy LMP + MIN (\$25/MWh, 50% of RQ run Energy LMP)

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Thermal Storage GS Energy Offers - Dispatch Data

PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	50	217

Hydro Storage GS Energy Offers - Dispatch Data

PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	50	87

Solar GS Energy Offers - Dispatch Data

PQ #	Price (\$/MWh)	Quantity (MW)
1	0	0
2	0	1
3	10	5

Thermal + Hydro Aggregated Energy Reference Quantity
310

Thermal GS Energy Reference Quantity
220

Thermal GS Energy LMP
180

Hydro GS Energy Reference Quantity
90

Hydro GS Energy LMP
180

Solar GS Energy Reference Quantity
5

Solar GS Energy LMP
180

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Thermal MCE Conduct Test	
Aggregated Maximum Offer Lamination	304
Is the conduct test carried out?	Yes
Conduct test threshold	$310 - 5 = 305$
Conduct test outcome	Fail
Thermal MWs Failed	$220 - 217 = 3$

Hydro MCE Conduct Test	
Aggregated Maximum Offer Lamination	304
Is the conduct test carried out?	Yes
Conduct test threshold	$310 - 5 = 305$
Conduct test outcome	Fail
Hydro MWs Failed	$90 - 87 = 3$

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Thermal Impact Test	
Impact test needed?	Yes
For which constrained area is the impact test performed for?	NCA 1
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$25 = \$95/\text{MWh}$

Hydro Impact Test	
Impact test needed?	Yes
For which constrained area is the impact test performed for?	NCA 1
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$25 = \$95/\text{MWh}$

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Thermal GS Outcome	Mitigation applied via settlement charge
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Settlement Charge	
Thermal GS MWhs Failed	3
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice for Thermal GS	\$810

Ex-Post PW Mitigation: Energy – Multiple Resources – NCA

Hydro GS Outcome	Mitigation applied via settlement charge
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Settlement Charge	
Hydro GS MWhs Failed	3
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice for Thermal GS	\$810

Ex-Post PW Mitigation: OR – Hydro – Global

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	150 MW

10S OR LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	Operating Reserve - Global
Conduct test threshold	10S OR RQ - MIN(10% of 10S OR RQ, 100 MW)
Impact test threshold	RQ run 10S OR LMP + MIN (\$25/MWh, 50% of RQ run 10S OR LMP)

10S OR Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	40	60
4	50	75

10S OR Reference Quantity
90

Ex-Post PW Mitigation: OR – Hydro – Global

Conduct Test	
Maximum Offer Lamination	75
Is the conduct test carried out?	Yes
Conduct test threshold	$90 - 9 = 81$
Conduct test outcome	Fail
MWhs Failed	$90 - 75 = 15$

Impact Test	
Impact test needed?	Yes
Simulated 10S OR LMP from as-offered run	\$180/MWh
Simulated 10S OR LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$25 = \$95/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: OR – Hydro – Global

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	15
10S OR LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWHs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$4,050

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	250 MW

Resource Information	
Resource Name	Hydro GS
Technology type of resource	Hydroelectric
Capacity	150 MW

Resource Information	
Resource Name	Dispatchable Load TS
Technology type of resource	Dispatchable Load
Capacity	25 MW

Constrained Area Type and Applicable Test Threshold	
Constrained area	Operating Reserve Local
Constrained area Name	OR Local Area 1
Conduct test threshold	10S OR RQ - 5 MW
Impact test threshold	RQ run 10S OR LMP

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Thermal Storage GS 10S Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	50	217

Hydro GS 10S Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	50	87

Dispatchable Load TS 10S Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	0	0
2	0	1
3	10	5

Thermal + Hydro Aggregated 10S Reference Quantity
310

Thermal GS 10S Reference Quantity
220

Thermal GS 10S OR LMP
180

Hydro GS 10S Reference Quantity
90

Hydro GS 10S OR LMP
180

Dispatchable Load TS 10S Reference Quantity
5

Dispatchable Load TS 10S OR LMP
180

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Thermal MCE Conduct Test	
Aggregated Maximum Offer Lamination	304
Is the conduct test carried out for the Thermal GS?	Yes
Conduct test threshold	$310 - 5 = 305$
Conduct test outcome	Fail
MWhs Failed	3

Hydro MCE Conduct Test	
Aggregated Maximum Offer Lamination	304
Is the conduct test carried out for the Hydro GS?	Yes
Conduct test threshold	$310 - 5 = 305$
Conduct test outcome	Fail
MWhs Failed	3

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Thermal MCE Impact Test	
Impact test needed?	Yes
For which constrained area is the impact test performed for?	OR Local Area 1
Simulated 10S OR LMP from as-offered run	\$180/MWh
Simulated 10S OR LMP from reference level run	\$70/MWh
Impact test threshold	\$70/MWh
Impact test outcome	Fail

Hydro MCE Impact Test	
Impact test needed?	Yes
For which constrained area is the impact test performed for?	OR Local Area 1
Simulated 10S OR LMP from as-offered run	\$180/MWh
Simulated 10S OR LMP from reference level run	\$70/MWh
Impact test threshold	\$70/MWh
Impact test outcome	Fail

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Thermal GS Outcome	Mitigation applied via settlement charge
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Settlement Charge	
Thermal GS MWhs Failed	3
10S OR LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice for Thermal GS	\$810

Ex-Post PW Mitigation: OR – Multiple Resources – Local

Hydro GS Outcome	Mitigation applied via settlement charge
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Settlement Charge	
Hydro GS MWhs Failed	3
10S OR LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice for Thermal GS	\$810

Next Steps

March 1: Deadline for comments following the February TP meeting

March 8: IESO will post:

- responses to feedback received following the January TP session; and
- updated MPM draft market manuals and market rules

March 22: TP meeting for vote to recommend on MPM draft market rules

Thank You

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Appendix



Constrained Areas Scenarios

Intertie Withholding – OR

Determination of Intertie Reference Level

- See spreadsheet for the determination of the Intertie Reference Level
- Importer offers operating reserve at the same price every day: \$150
- Intertie Reference Level = \$150

Constrained Areas: Intertie Withholding – OR

Resource Information	
Resource Name	IZA.IMPORT.ONT.SOURCE.01
Import or Export	Import
Uncompetitive Intertie Zone	Intertie Zone A

30R OR LMP
500

Constrained Area Type and Applicable Test Threshold	
Constrained area	Uncompetitive Intertie Zone
Conduct test threshold	30R OR IRL + MIN(50% of 30R OR IRL, \$25/MWh)
Impact test threshold	IRL run 30R OR LMP + MIN (\$25/MWh, 50% of IRL run 30R OR LMP)

30R Operating Reserve Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	500	0
2	500	100

30R Import Offer Reference Level		
PQ #	Price (\$/MWh)	Quantity (MW)
1	150	0
2	150	100

Constrained Areas: Intertie Withholding – OR

Conduct Test	
Lamination	0-100 MW
Offer Price	\$500/MW
Is the conduct test carried out?	Yes
Conduct test threshold	$\$150 + \$25 = \$175/\text{MW}$
Conduct test outcome	Fail
MWHs Failed	100 MWhs

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Intertie Reference Level
Simulated 30R OR LMP from as-offered run	\$500/MWh
Simulated 30R OR LMP from reference level run	\$150/MWh
Impact test threshold	$\$150 + \$25 = \$175/\text{MWh}$
Impact test outcome	Fail

Constrained Areas: Intertie Withholding – OR

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	100
30R OR LMP	\$500
Settlement charge appearing on 1st notice	\$50,000



Ex-Ante Mitigation for Economic Withholding Scenarios

Ex-ante Mitigation: Energy – Thermal – BCA

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	100 MW
MLP	20 MW

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RL + MIN(300% of Energy RL, \$100/MWh)
Impact test threshold	RL run Energy LMP + MIN (\$50/MWh, 100% of RL run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	20
3	40	40
4	50	60
5	200	100

Energy Offer Reference Level		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	20
3	35	40
4	50	60
5	60	100

Ex-ante Mitigation: Energy – Thermal – BCA

Conduct Test			
Lamination	20.1-40 MWh	40.1-60 MWh	60.1-100 MWh
Offer Price	\$40/MWh	\$50/MWh	\$200/MWh
Is the conduct test carried out?	Yes	Yes	Yes
Conduct test threshold	$\$35 + \$100 = \$135/\text{MWh}$	$\$50 + \$100 = \$150/\text{MWh}$	$\$60 + \$100 = \$160/\text{MWh}$
Conduct test outcome	Pass	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
Energy LMP from as-offered run	\$200/MWh
Energy LMP from reference level run	\$60/MWh
Impact test threshold	$\$60 + \$50 = \$110/\text{MWh}$
Impact test outcome	Fail

Ex-ante Mitigation: Energy – Thermal – BCA

Outcome	Mitigation applied
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Energy Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	20
3	35	40
4	50	60
5	60	100

Ex-ante Mitigation: Energy – Variable – BCA

Resource Information	
Resource Name	Variable GS
Technology type of resource	Wind
Capacity	100 MW
Location	Toronto

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RL + MIN(300% of Energy RL, \$100/MWh)
Impact test threshold	RL run Energy LMP + MIN (\$50/MWh, 100% of RL run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	20
3	40	40
4	50	60
5	200	100

Energy Offer Reference Level		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	20
3	35	40
4	50	60
5	60	100

Ex-ante Mitigation: Energy – Variable – BCA

Conduct Test				
Lamination	0-20 MWh	20.1-40 MWh	40.1-60 MWh	60.1-100 MWh
Offer Price	\$30/MWh	\$40/MWh	\$50/MWh	\$200/MWh
Is the conduct test carried out?	Yes	Yes	Yes	Yes
Conduct test threshold	$4 * \$25 = \$100/\text{MWh}$	$\$25 + \$100 = \$135/\text{MWh}$	$\$50 + \$100 = \$150/\text{MWh}$	$\$60 + \$100 = \$160/\text{MWh}$
Conduct test outcome	Pass	Pass	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
Energy LMP from as-offered run	\$200/MWh
Energy LMP from reference level run	\$60/MWh
Impact test threshold	$\$60 + \$50 = \$110/\text{MWh}$
Impact test outcome	Fail

Ex-ante Mitigation: Energy – Variable – BCA

Outcome	Mitigation applied
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Energy Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	25	0
2	25	20
3	35	40
4	50	60
5	60	100

Ex-ante Mitigation: OR – Thermal – Global

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	100 MW
MLP	20 MW

Constrained Area Type and Applicable Test Threshold	
Condition	Global Market Power
Conduct threshold	30R OR RL + MIN(\$25/MW, 50% of 30R OR RL)
Impact threshold	RL run 30R OR LMP + MIN(\$25/MW, 50% of RL run 30R OR LMP)

30R Operating Reserve Offers		
PQ #	Price (\$/MW)	Quantity (MW)
1	8	0
2	8	40
3	11	80

30R Operating Reserve Offer Reference Level		
PQ #	Price (\$/MW)	Quantity (MW)
1	6	0
2	6	40
3	7	80

Ex-ante Mitigation: OR – Thermal – Global

Conduct Test		
Lamination	0-40 MW	40.1-80 MW
Offer Price	\$8/MW	\$11/MW
Is the conduct test carried out?	Yes	Yes
Conduct test threshold + RL	$\$6 + \$3 = \$9/\text{MW}$	$\$7 + \$3.50 = \$10.50/\text{MW}$
Conduct test outcome	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
30R OR LMP from as-offered run	\$11/MW
30R OR LMP from reference level run	\$7/MW
Impact test threshold	$\$7 + \$3.50 = \$10.50/\text{MW}$
Impact test outcome	Fail

Ex-ante Mitigation: OR – Thermal – Global

Outcome	Mitigation applied
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30R OR Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	6	0
2	6	50
3	7	100

Ex-ante Mitigation: OR – Storage – Global

Resource Information	
Resource Name	Storage GS
Technology type of resource	Storage
Capacity	100 MW

Constrained Area Type and Applicable Test Threshold	
Condition	Global Market Power
Conduct threshold	10S OR RL + MIN(\$25/MW, 50% of 10S OR RL)
Impact threshold	RL run 10S OR LMP + MIN(\$25/MW, 50% of RL run 10S OR LMP)

10S Operating Reserve Offers		
PQ #	Price (\$/MW)	Quantity (MW)
1	8	0
2	8	50
3	11	100

10S Operating Reserve Offer Reference Level		
PQ #	Price (\$/MW)	Quantity (MW)
1	6	0
2	6	50
3	7	100

Ex-ante Mitigation: OR – Storage – Global

Conduct Test		
Lamination	0-50 MW	50.1-100 MW
Offer Price	\$8/MW	\$11/MW
Is the conduct test carried out?	Yes	Yes
Conduct test threshold + RL	$\$6 + \$3 = \$9/\text{MW}$	$\$7 + \$3.50 = \$10.50/\text{MW}$
Conduct test outcome	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
10S OR LMP from as-offered run	\$11/MW
10S OR LMP from reference level run	\$7/MW
Impact test threshold	$\$7 + \$3.50 = \$10.50/\text{MW}$
Impact test outcome	Fail

Ex-ante Mitigation: OR – Storage – Global

Outcome	Mitigation applied
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10S OR Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	6	0
2	6	50
3	7	100

Ex-ante Mitigation: OR – DL w/BTM Storage – Global

Resource Information	
Resource Name	Dispatchable Load
BTM Storage?	Yes
Maximum Dispatchable Load	100 MW

Constrained Area Type and Applicable Test Threshold	
Condition	Global Market Power
Conduct threshold	10S OR RL + MIN(\$25/MW, 50% of 10S OR RL)
Impact threshold	RL run 10S OR LMP + MIN(\$25/MW, 50% of RL run 10S OR LMP)

10S Operating Reserve Offers		
PQ #	Price (\$/MW)	Quantity (MW)
1	11	0
2	11	50
3	20	100

10S Operating Reserve Offer Reference Level		
PQ #	Price (\$/MW)	Quantity (MW)
1	10	0
2	10	50
3	12	100

Ex-ante Mitigation: OR – DL w/BTM Storage – Global

Conduct Test		
Lamination	0-50 MW	50.1-100 MW
Offer Price	\$11/MW	\$20/MW
Is the conduct test carried out?	Yes	Yes
Conduct test threshold + RL	$\$10 + \$5 = \$15/\text{MW}$	$\$12 + \$6 = \$18/\text{MW}$
Conduct test outcome	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
10S OR LMP from as-offered run	\$20/MW
10S OR LMP from reference level run	\$12/MW
Impact test threshold	$\$12 + \$6 = \$18/\text{MW}$
Impact test outcome	Fail

Ex-ante Mitigation: OR – DL w/BTM Storage – Global

Outcome	Mitigation applied
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10S OR Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	10	0
2	10	50
3	12	100

Ex-ante Mitigation: OR – DL w/out BTM Storage – Global

Resource Information	
Resource Name	Dispatchable Load
BTM Storage?	No
Maximum Dispatchable Load	100 MW

Constrained Area Type and Applicable Test Threshold	
Condition	Global Market Power
Conduct threshold	10S OR RL + MIN(\$25/MW, 50% of 10S OR RL)
Impact threshold	RL run 10S OR LMP + MIN(\$25/MW, 50% of RL run 10S OR LMP)

10S Operating Reserve Offers		
PQ #	Price (\$/MW)	Quantity (MW)
1	8	0
2	8	50
3	11	100

10S Operating Reserve Offer Reference Level		
PQ #	Price (\$/MW)	Quantity (MW)
1	6	0
2	6	50
3	7	100

Ex-ante Mitigation: OR – DL w/out BTM Storage – Global

Conduct Test		
Lamination	0-50 MW	50.1-100 MW
Offer Price	\$8/MW	\$11/MW
Is the conduct test carried out?	Yes	Yes
Conduct test threshold + RL	$\$6 + \$3 = \$9/\text{MW}$	$\$7 + \$3.50 = \$10.50/\text{MW}$
Conduct test outcome	Pass	Fail

Impact Test	
Impact test needed?	Yes
Offer that will be used in RL run	Reference Level
10S OR LMP from as-offered run	\$11/MW
10S OR LMP from reference level run	\$7/MW
Impact test threshold	$\$7 + \$3.50 = \$10.50/\text{MW}$
Impact test outcome	Fail

Ex-ante Mitigation: OR – DL w/out BTM Storage – Global

Outcome	Mitigation applied
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10S OR Offers after Mitigation		
PQ #	Price (\$/MWh)	Quantity (MW)
1	6	0
2	6	50
3	7	100



Ex-Post Mitigation for Physical Withholding Scenarios

Ex-Post PW Mitigation: Energy – Thermal – BCA

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	250 MW

Energy LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RQ - MIN(10% of Energy RQ, 100 MW)
Impact test threshold	RQ run Energy LMP + MIN (\$50/MWh, 100% of RQ run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	40	60
4	50	75

Energy Reference Quantity
220

Ex-Post PW Mitigation: Energy – Thermal – BCA

Conduct Test	
Maximum Offer Lamination	75
Is the conduct test carried out?	Yes
Conduct test threshold	$220 - 22 = 198$
Conduct test outcome	Fail
MWhs Failed	$220 - 75 = 145$

Impact Test	
Impact test needed?	Yes
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$50 = \$120/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: Energy – Thermal – BCA

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	145
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$39,150

Ex-Post PW Mitigation: Energy – Variable – BCA

Resource Information	
Resource Name	Solar GS
Technology type of resource	Solar
Capacity	25 MW

Energy LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RQ - MIN(10% of Energy RQ, 100 MW)
Impact test threshold	RQ run Energy LMP + MIN (\$50/MWh, 100% of RQ run Energy LMP)

Energy Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	0	0
2	0	1
3	1	2
4	10	3

Energy Reference Quantity
5

Ex-Post PW Mitigation: Energy – Variable – BCA

Conduct Test	
Maximum Offer Lamination	3
Is the conduct test carried out?	Yes
Conduct test threshold	$5 - 0.5 = 4.5$
Conduct test outcome	Fail
MWhs Failed	$5 - 3 = 2$

Impact Test	
Impact test needed?	Yes
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$30/MWh
Impact test threshold	$\$30 + \$30 = \$60/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: Energy – Variable – BCA

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	2
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$540

Ex-Post PW Mitigation: Energy – Storage – BCA

Resource Information	
Resource Name	Storage GS
Technology type of resource	Battery
Capacity	15 MW

Energy LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	BCA
Conduct test threshold	Energy RQ - MIN(10% of Energy RQ, 100 MW)
Impact test threshold	RQ run Energy LMP + MIN (\$50/MWh, 100% of RQ run Energy LMP)

Ex-Post PW Mitigation: Energy – Storage – BCA

Energy Offers - Dispatch Data			
HE	PQ #	Price (\$/MWh)	Quantity (MW)
1	n/a	n/a	n/a
2	n/a	n/a	n/a
3	n/a	n/a	n/a
4	n/a	n/a	n/a
5	n/a	n/a	n/a
6	n/a	n/a	n/a
7	n/a	n/a	n/a
8	n/a	n/a	n/a
9	n/a	n/a	n/a
10	n/a	n/a	n/a
11	n/a	n/a	n/a
12	n/a	n/a	n/a
13	n/a	n/a	n/a
14	n/a	n/a	n/a
15	n/a	n/a	n/a

Energy Offers - Dispatch Data			
HE	PQ #	Price (\$/MWh)	Quantity (MW)
16	n/a	n/a	n/a
17	n/a	n/a	n/a
	1	1	0
18	2	1	2
	3	10	3
19	n/a	n/a	n/a
20	n/a	n/a	n/a
21	n/a	n/a	n/a
22	n/a	n/a	n/a
23	n/a	n/a	n/a
24	n/a	n/a	n/a

Energy Reference Quantity
15

Ex-Post PW Mitigation: Energy – Storage – BCA

Conduct Test	
Maximum Offer Lamination	3
Is the conduct test carried out?	Yes
Conduct test threshold	$15 - 1.5 = 13.5$
Conduct test outcome	Fail
MWhs Failed	$15 - 3 = 12$

Impact Test	
Impact test needed?	Yes
Simulated Energy LMP from as-offered run	\$180/MWh
Simulated Energy LMP from reference quantity run	\$30/MWh
Impact test threshold	$\$30 + \$30 = \$60/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: Energy – Storage – BCA

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	12
Energy LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$3,240

Ex-Post PW Mitigation: OR – DL w/BTM Storage – Global

Resource Information	
Resource Name	Dispatchable Load with BTM Storage
Technology type of resource	DL
Capacity	15 MW

10S OR LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	Operating Reserve - Global
Conduct test threshold	10S OR RQ - MIN(10% of 10S OR RQ, 100 MW)
Impact test threshold	RQ run 10S OR LMP + MIN (\$25/MWh, 50% of RQ run 10S OR LMP)

10S OR Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	0	0
2	0	1
3	1	2
4	10	3

10S OR Reference Quantity
5

Ex-Post PW Mitigation: OR – DL w/BTM Storage – Global

Conduct Test	
Maximum Offer Lamination	3
Is the conduct test carried out?	Yes
Conduct test threshold	$5 - 0.5 = 4.5$
Conduct test outcome	Fail
MWhs Failed	$5 - 3 = 2$

Impact Test	
Impact test needed?	Yes
Simulated 10S OR LMP from as-offered run	\$180/MW
Simulated 10S OR LMP from reference quantity run	\$30/MW
Impact test threshold	$\$30 + \$30 = \$60/\text{MW}$
Impact test outcome	Fail

Ex-Post PW Mitigation: OR – DL w/BTM Storage – Global

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	2
10S OR LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$540

Ex-Post PW Mitigation: OR – DL w/out BTM Storage – Global

Resource Information	
Resource Name	Dispatchable Load without BTM Storage
Technology type of resource	DL
Capacity	15 MW

10S OR LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	Operating Reserve - Global
Conduct test threshold	10S OR RQ - MIN(10% of 10S OR RQ, 100 MW)
Impact test threshold	RQ run 10S OR LMP + MIN (\$25/MWh, 50% of RQ run 10S OR LMP)

10S OR Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	0	0
2	0	1
3	1	2
4	10	3

10S OR Reference Quantity
5

Ex-Post PW Mitigation: OR – DL w/out BTM Storage – Global

Conduct Test	
Maximum Offer Lamination	3
Is the conduct test carried out?	Yes
Conduct test threshold	$5 - 0.5 = 4.5$
Conduct test outcome	Fail
MWhs Failed	$5 - 3 = 2$

Impact Test	
Impact test needed?	Yes
Simulated 10S OR LMP from as-offered run	\$180/MW
Simulated 10S OR LMP from reference quantity run	\$30/MW
Impact test threshold	$\$30 + \$30 = \$60/\text{MW}$
Impact test outcome	Fail

Ex-Post PW Mitigation: OR – DL w/out BTM Storage – Global

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	2
10S OR LMP	\$180
Persistence Multiplier	1
Calculation Formula	$1.5 * [\text{MWhs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$540

Ex-Post PW Mitigation: OR – Thermal – Global

Resource Information	
Resource Name	Thermal GS
Technology type of resource	Thermal
Capacity	250 MW

30R OR LMP
180

Constrained Area Type and Applicable Test Threshold	
Constrained area	Operating Reserve - Global
Conduct test threshold	30R OR RQ - MIN(10% of 30R OR RQ, 100 MW)
Impact test threshold	RQ run 30R OR LMP + MIN (\$25/MWh, 50% of RQ run 30R OR LMP)

30R OR Offers - Dispatch Data		
PQ #	Price (\$/MWh)	Quantity (MW)
1	30	0
2	30	50
3	50	75

30R OR Reference Quantity
220

Ex-Post PW Mitigation: OR – Thermal – Global

Conduct Test	
Maximum Offer Lamination	75
Is the conduct test carried out?	Yes
Conduct test threshold	$220 - 22 = 198$
Conduct test outcome	Fail
MWhs Failed	$220 - 75 = 145$

Impact Test	
Impact test needed?	Yes
Simulated 30R OR LMP from as-offered run	\$180
Simulated 30R OR LMP from reference quantity run	\$70/MWh
Impact test threshold	$\$70 + \$25 = \$95/\text{MWh}$
Impact test outcome	Fail

Ex-Post PW Mitigation: OR – Thermal – Global

Outcome	Mitigation applied via settlement charge
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Settlement Charge	
MWHs Failed	145
30R OR LMP	\$180
Persistence Multiplier	1
Calculation	$1.5 * [\text{MWHs Failed}] * [\text{LMP}] * [\text{Persistence Multiplier}]$
Settlement charge appearing on 1st notice	\$39,150