Market Renewal Program: Day Ahead Market (DAM)

Stakeholder Engagement Session 8

Sept 20, 2018

ieso
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Powering Tomorrow.

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Preliminary Decisions

- Stakeholders have asked the IESO to bring forward preliminary decisions where possible.
- These materials identify preliminary decisions and offer supporting rationale.
- The IESO has made preliminary decisions where there is a single viable option, or where internal analysis has led the IESO to propose a specific solution
- Stakeholders are requested to use meeting time to discuss these preliminary decisions, and are also invited to provide written feedback.
- Preliminary decisions are non-binding, are intended to facilitate progress on design elements, and are subject to final decision-making at the High Level Design Phase.

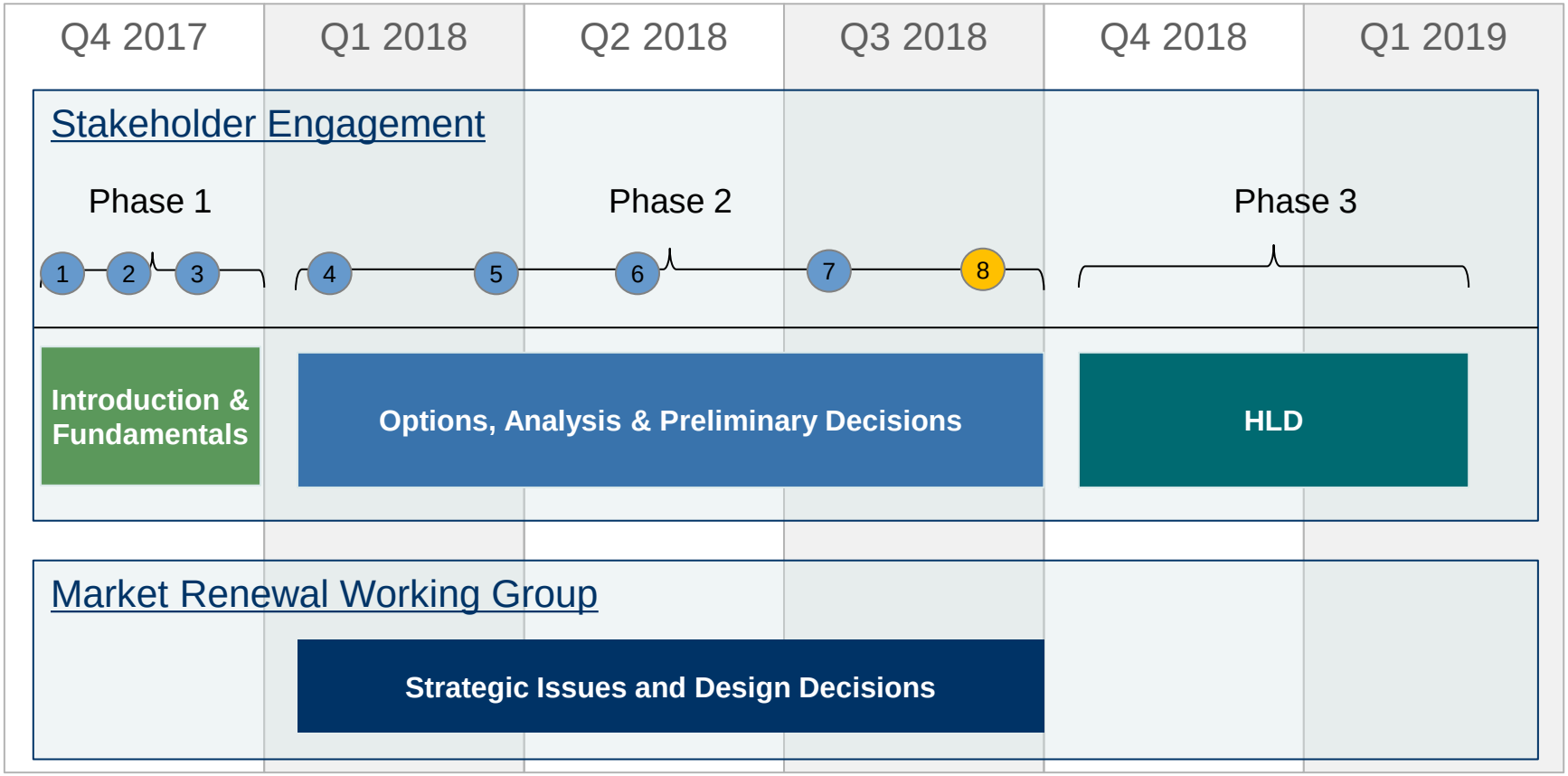
Today's Agenda

1. DAM project plan update for high level design
   - Where we are, what has been done and what is next

2. Design elements for today's discussion
   - Present preliminary decisions for new secondary level decisions

3. Next Steps
   - Stakeholder feedback
   - High Level Design review

DAM Project Timeline for High Level Design



Design Elements for Discussion Today

Design Modules		Design Elements		Preliminary Decisions	
				Primary	Secondary
A	Participation and Input Data	1	Offer Obligations	Completed	N/A
		2	Load Participation	Completed	Today
		3	Supply Participation: Variable Generation	Completed	Completed
		4	Reliability Input Parameters	Completed	N/A
		5	Virtual Transactions	Completed	Completed
B	Execution, Timing and Real-Time Integration	6	Functional Passes	Completed	Completed
		7	Optimization of ELRs	Completed	Today
		8	Submission and Posting Deadlines	Completed	N/A
		9	Initiation of Operational Commitments	Completed	N/A
		10	Market Power Mitigation	Completed	Completed
		11	Price Setting Eligibility	Completed	N/A
		12	Reporting Obligations	Completed	N/A
C	Settlements	13	Two Settlement for Load	Completed	Today
		14	Two Settlement for Supply	Completed	N/A
		15	Make Whole Payments	Completed	Today
		16	Uplift Recovery	Completed	Completed
		17	Financial Transmission Rights	Completed	N/A
		18	Market System Failure	Completed	N/A

Meeting Objectives and Outcomes

- Provide rationale for each of today's preliminary decisions:
  - IESO moving to zonal demand forecasting
  - Settlement of Hourly Demand Response (HDR) bids in DAM
  - Software requirements to facilitate the optimization of dispatchable hydro-electric resources in DAM and pre-dispatch
  - Guidelines for determining real-time make whole payments during detailed design
  - Capturing NQS resource ramp schedules in the DAM

- Close out preliminary decisions phase and communicate expectations for stakeholder feedback and review of HLD documentation

DESIGN ELEMENT DISCUSSIONS

GLOBAL vs. ZONAL IESO LOAD FORECASTS

Recap: Design Considerations

- The DAM will schedule resources to meet non-dispatchable load (NDL) that will continue to be forecasted by the IESO

- This prompted the IESO to look into increasing the granularity of its NDL forecast because a more accurate load distribution will:
  - Improve DAM to real-time price convergence and encourage efficient DAM participation
  - Improve the efficiency of DAM unit commitment and scheduling, reducing out-of-market payments

- Today's meeting presents a preliminary decision on the granularity that is to be used for the NDL forecast.

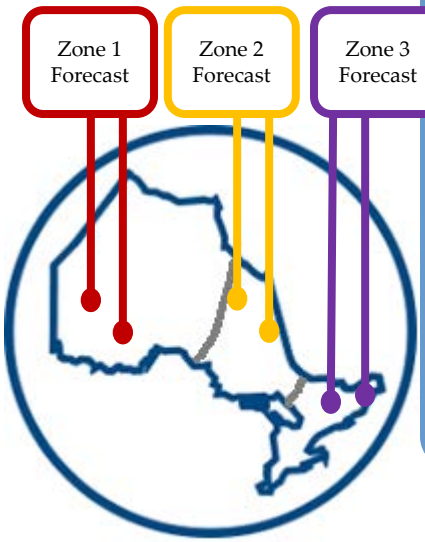
Forecast Granularity Options

- The IESO looked into the feasibility of moving from a less granular, global forecast to a more granular, zonal forecast

Global NDL Forecast

Less granular, global forecasts can produce a less efficient unit commitment and DAM prices because a global forecast is a less accurate representation of where load is being consumed.

Zonal NDL Forecast**



More granular, zonal forecasts can produce a more efficient unit commitment and DAM prices because a zonal forecast is a more accurate representation of where load is being consumed.

**Note – 3 zones used for illustrative purposes only

Preliminary Decision and Rationale

Preliminary Decision	Rationale
The IESO will move to zonal forecasting for NDL and manage forecast accuracy on a zonal basis.	• A more accurate load distribution will increase price convergence and the efficiency of the day-ahead unit commitment • Moving to a more granular load forecast is feasible

Detailed Design Considerations

- Determine appropriate forecast zones
  - It may be more practical to amalgamate one or more of the existing zones. For example, including the Bruce zone, which has low load relative to supply, within the Southwest zone.
  - Factors to consider include magnitude of load, quality of input data, and forecast accuracy that can be achieved

- Review zonal forecast accuracy
  - Determine reasonable targets for each zone
  - Considerations include the quality and quantity of input data for historical demand, weather and embedded generation

TWO SETTLEMENT FOR HOURLY DEMAND RESPONSE (HDR) RESOURCES

Recap: Design Considerations

- HDR resources currently participate in DACP. Their bids are economically evaluated against other dispatchable resources and therefore influence DACP schedules.

- This design element considers whether HDR bids into the DAM would receive financially binding schedules and be exposed to DAM and real-time balancing settlements

- Real-time balancing settlements require metered real-time consumption however HDR resources can currently represent embedded load contributors that are neither settled nor metered with the IESO.

Preliminary Decision and Rationale

Preliminary Decision	Rationale
HDR bids submitted into the DAM would be exposed to a DAM settlement and a real-time balancing settlement.	• Exposing HDR bids to DAM and real-time balancing settlements is efficient because, like other dispatchable load resources, they would be incentivized to bid in their marginal benefit of consumption in both DAM and real-time.

Detailed Design Considerations

- Most HDR are aggregate resources that represent a collection of contributors that can include both:
  - Registered market participant loads that are metered and settled by the IESO (e.g. an industrial load); and
  - Embedded loads that are metered and settled by an LDC rather than with the IESO

- A lack of metering with the IESO presents challenges in determining who should bear the financial responsibilities of HDR bids that clear the DAM – the HDR aggregator submitting the bids, the embedded contributor, or the LDC?

Detailed Design Considerations

- Coordination with the DR working group is required to determine whether changes to DR participation rules are needed for Day 1 of the DAM.
  - HDR bids representing metered market participants poses less of an settlement issue because DAM schedules can be accurately mapped to actual real-time consumption
  - More work is required for HDR bids that represent embedded loads

- Coordination with the ICA project would also be required to determine whether changes to DR participation rules are needed when DR is integrated into the ICA.

OPTIMIZATION OF ENERGY LIMITED RESOURCES (ELRS)

Recap: Design Scope and Rationale

- In lieu of an ELR resubmission window in the DAM, additional operating characteristics may need to be respected in the DAM to increase the likelihood of dispatchable cascade hydro resources receiving a feasible day-ahead schedule.

- Additional hydro operating characteristics would also need to be respected by the new pre-dispatch (i.e. ERUC) to maintain scheduling certainty and efficiency as real-time approaches

Progress Since the July Meeting

- IESO met with dispatchable hydroelectric participants in August discuss proposed software requirements that were presented at the July meeting
- Feedback received has been incorporated into the final set of proposed software requirements presented today
- August meeting materials and feedback received can be found on the DAM stakeholder engagement webpage.

Newly Proposed Software Requirements

Preliminary Decision		Rationale
1	Ability to manage must run conditions	Respecting hydro-electric equipment, safety, regulatory or legal requirements will: • Increase the likelihood of hydro resources receiving a feasible schedule; and • Improve the optimization of all resources, including hydro, in DAM and pre-dispatch
2	Ability to limit the number of resource starts	
3	Ability to respect intertemporal dependencies between two or more resources on a cascade system	
4	Ability to specify multiple daily energy limits to represent quantities of water with different opportunity costs	
5	Ability to respect forbidden regions	

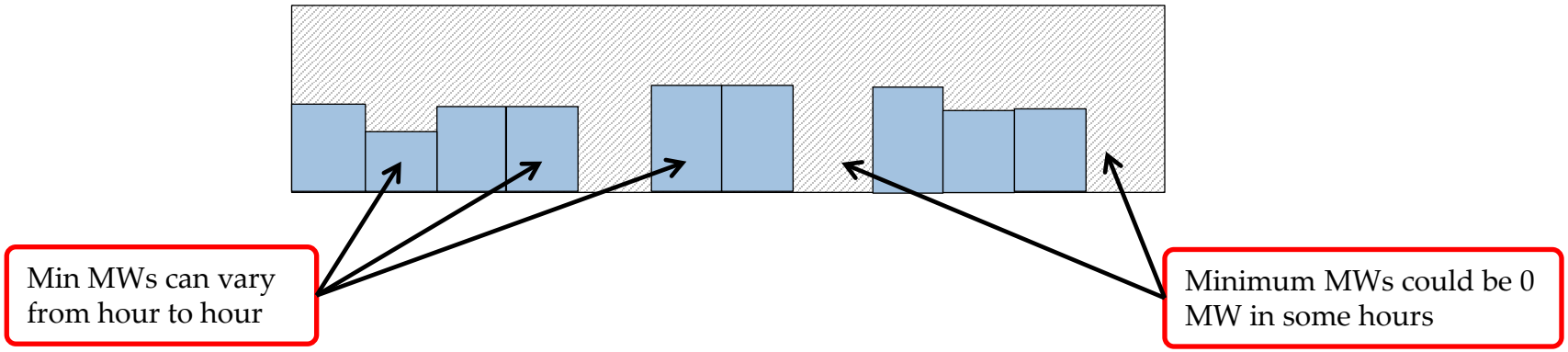
- These requirements are discussed in further detail in subsequent slides

Software Requirements To Be Maintained

Preliminary Decision		Rationale
6	Maintain ability for hydro resources to provide monotonically increasing hourly offers (i.e. PQ pairs)	PQ pairs are already a proven mechanism to facilitate the co-optimization of energy and operating reserve, allowing resources to be evaluated under one offer structure in DAM, pre-dispatch and real-time.
7	Maintain ability to schedule hydro-electric resources for energy and operating reserve above any minimum or below any maximum operating restrictions imposed by the new software requirements.	Maintains operational flexibility for the IESO.

1A. Managing Must Run Conditions

- The software solution should be able to respect minimum hourly MW schedules (i.e. non-dispatchable quantities that are applied to one or more hours of the day)

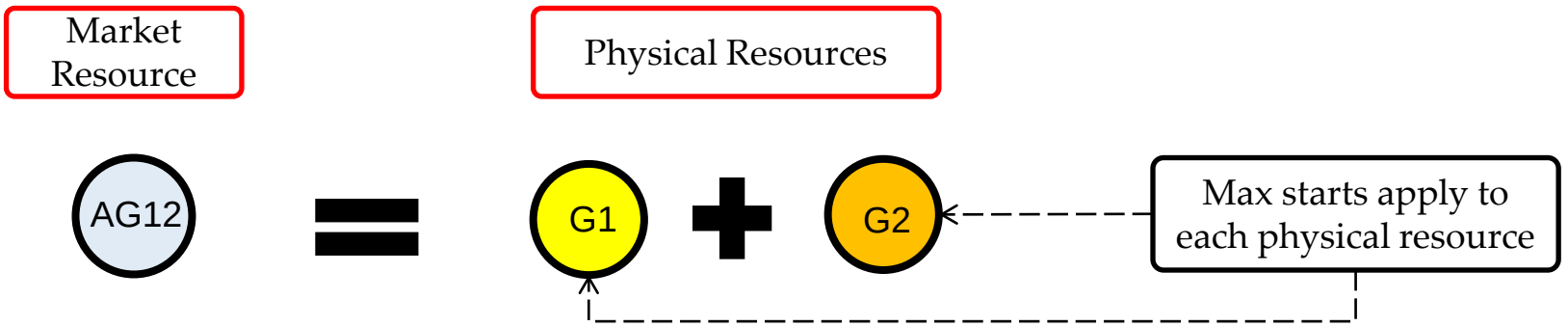


1B. Managing Must Run Conditions

- The software solution should also be able to respect minimum daily energy MWh requirements (i.e. minimum flow requirements that have scheduling flexibility throughout the day but must be met by the end of the day)

2. Max Resource Starts per Day

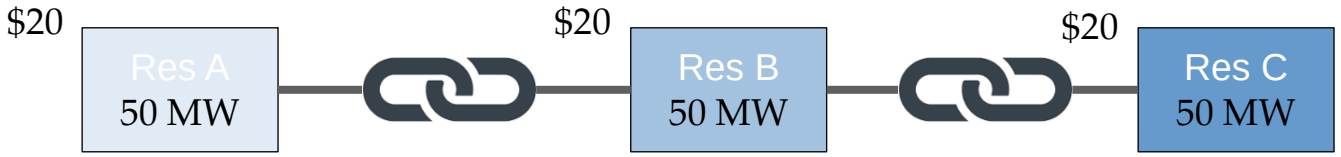
- Solution should be able to respect maximum number of resource starts per day. Hydro participants clarified that the maximum starts per day apply to physical resources rather than market resources.



- Distinguishing what MW level represents a physical resource start may present software challenges because the offer curve of a market resource currently has no mapping to physical resources.
- IESO will work on a resolution with stakeholders in detailed design.

3. Cascade Resource Dependencies

- Software solution should be able to provide users with the option of establishing scheduling dependencies between two or more resources such that all or none are economically scheduled.

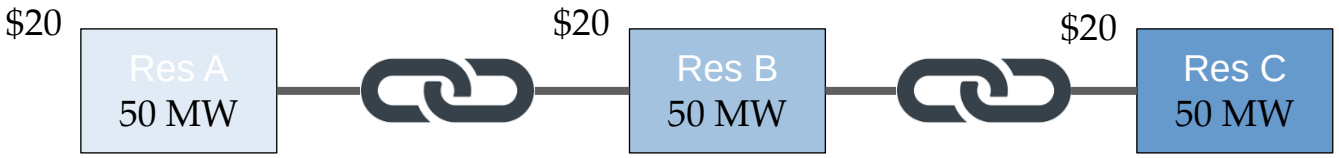


- Detailed design would determine whether linked resources would only be scheduled if they were:
  - All individually economic; or
  - Collectively economic

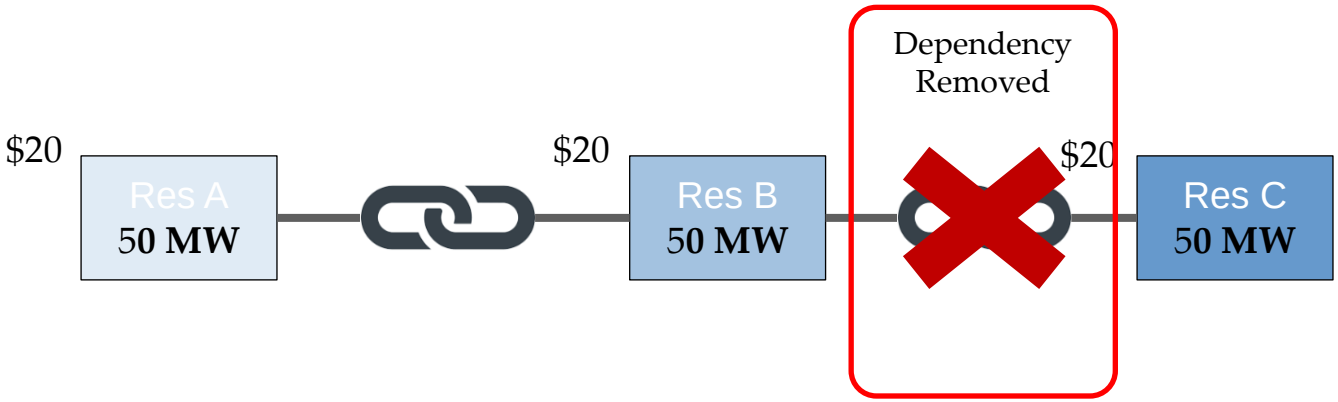
3. Cascade Resource Dependencies (cont'd)

- Users should also have the option of adding or removing dependencies after DAM and throughout the pre-dispatch timeframe in order to reflect changes in water management conditions.

Ex 1:
DAM dependencies



Ex 2:
Pre-dispatch dependencies



3. Cascade Resource Dependencies (cont'd)

Market Participant Feedback:

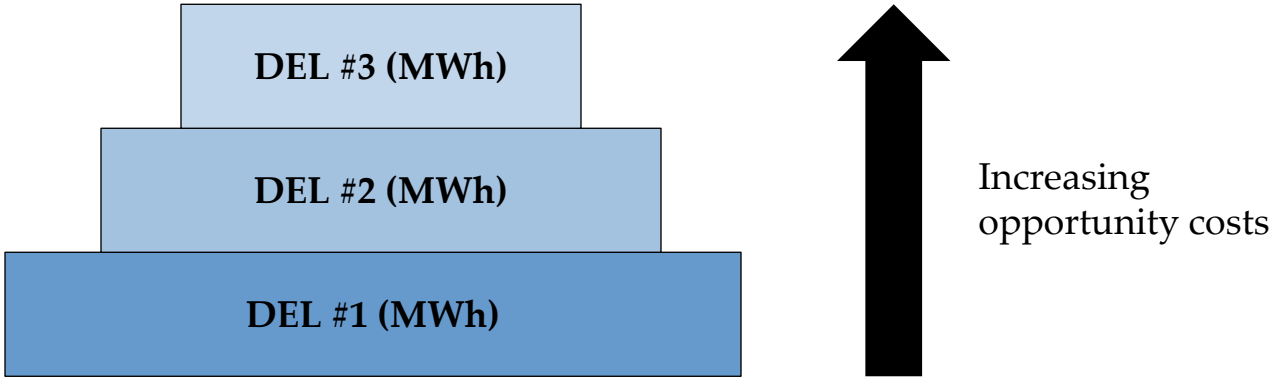
- Hydro participants asked whether they would have to manage dependencies between resources that are owned by different market participants.

IESO Response:

- No, the ability to establish scheduling dependencies between two or more resources would only available to resources under the operational control of a single market participant.

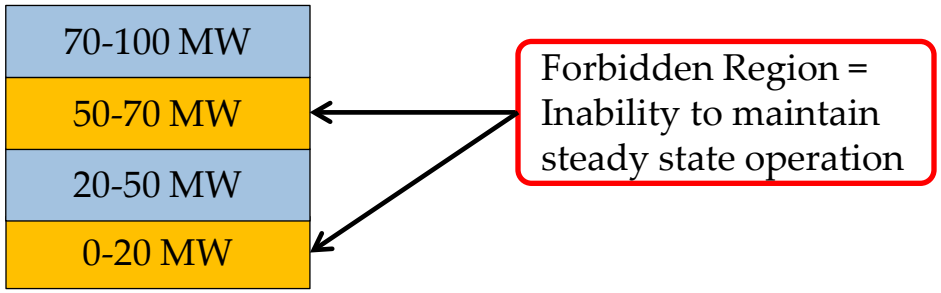
4. Multiple DELs per Resource

- Software solution should allow multiple Daily Energy Limit (DEL) values to be specified for a given resource and allow each DEL to be represented by a different opportunity cost of water



5. Forbidden Regions

- Software solution should respect one or more forbidden regions for a given resource
  - Forbidden regions are defined as a predefined operating range within which a hydroelectric facility cannot maintain steady operation without causing equipment damage.
- Forbidden regions are currently only respected in real-time. The capability will be expanded to DAM and pre-dispatch.



5. Forbidden Regions (cont'd)

Market Participant Feedback:

- Hydro participants noted that there is currently a limit to the number of forbidden regions that can be specified for a resource

IESO Response:

- The IESO will explore expanding the number of forbidden regions with the vendor during detailed design

Next Steps

- No further preliminary decisions required for high level design

- IESO will include the proposed software requirements in the vendor RFP

MAKE WHOLE PAYMENTS

Recap from the July Meeting

- At the July meeting, IESO presented several two-settlement supplier scenarios to show how our initially proposed real-time make-whole payment guidelines could result in inappropriate overpayments when constrained up or down events occur in both DAM and real-time.

- IESO noted that alternate guidelines would therefore be required to maintain dispatch incentives without generating unnecessary uplift costs in the form of make-whole overpayment.

Topics Covered Today

A. Additional two settlement scenarios, this time for dispatchable loads, will be presented to re-inforce the need for alternate real-time make-whole payment guidelines.

B. Preliminary decisions for the alternate real-time make-whole payment guidelines

A. MAKE-WHOLE PAYMENT SCENARIOS FOR DISPATCHABLE LOADS

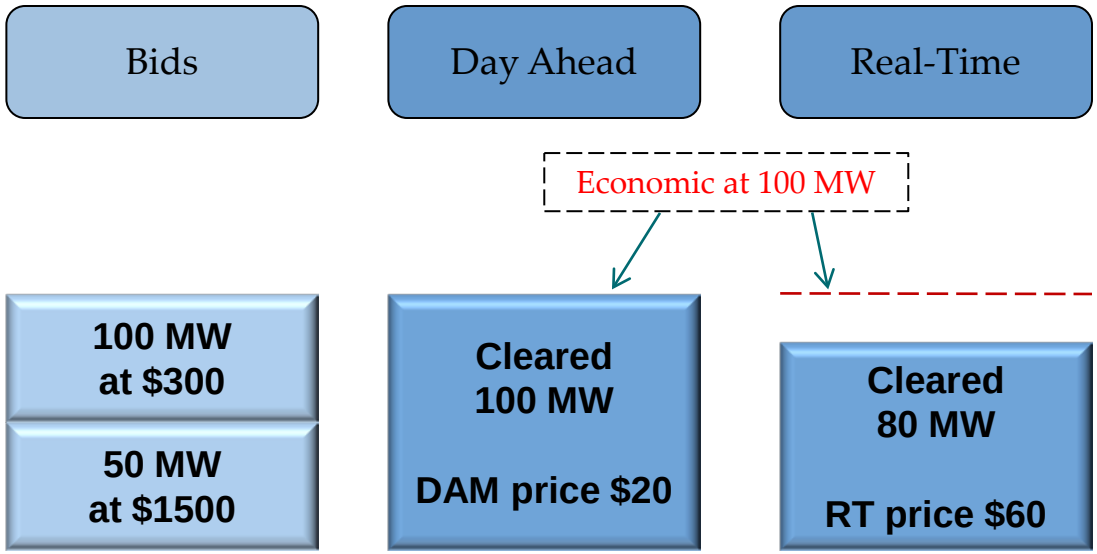
Scenario 1: Load scheduled economically in DAM & constrained-down in RT

- This scenario shows a load that is economically scheduled in DAM and receives a RT make-whole payment for being constrained down to a less economic level in RT.

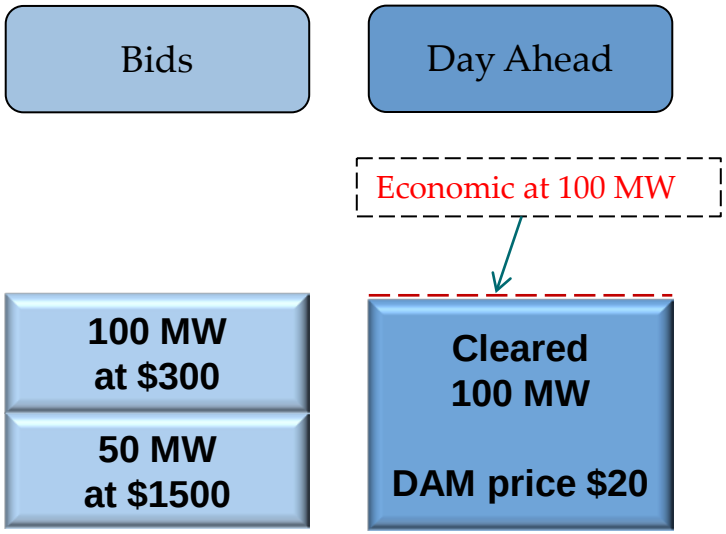
Scenario 1: Load scheduled economically in DAM & constrained-down in RT

Day-Ahead: The load is scheduled economically at 100 MW at a price of $20.

Real-Time: The load is constrained-down to 80 MW below its economic point of 100 MW at a price of $60.



Scenario 1: Settlement in DAM

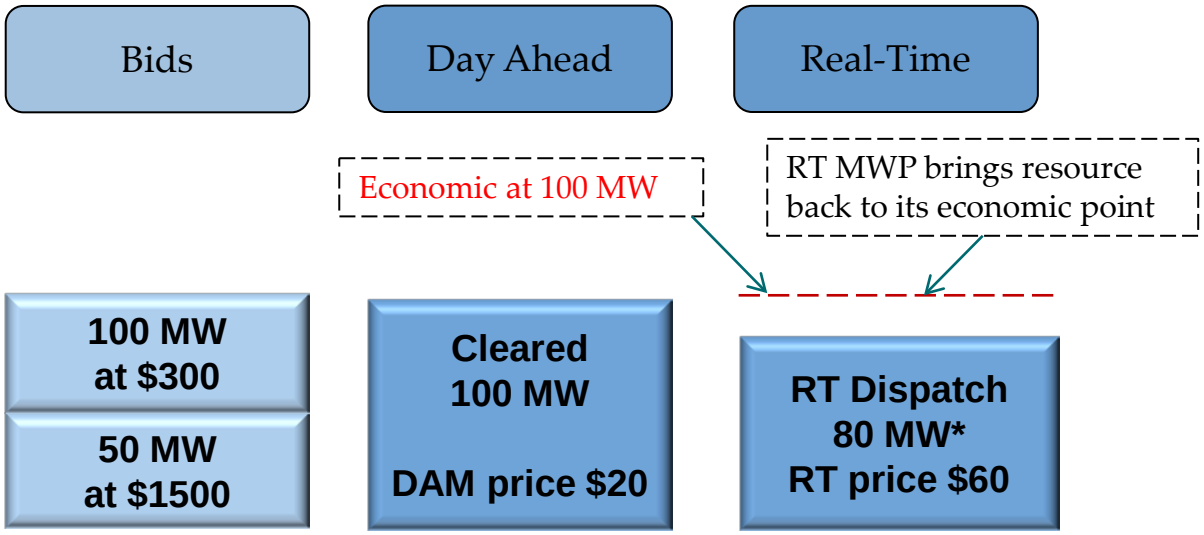


DAM Component	Total
DAM Energy Charge	-$2000
DAM Bid Costs	-$90000
DAM Make-Whole	$0
DAM Settlement	-$2000

Observation:

- Load is charged with a energy cost of -$2,000
- No DAM make whole because DAM energy charge is lower than the cost of consumption implied by the load's energy bids.

Scenario 1: Settlement in Real-Time



RT Balancing Settlement $(Q_{RT} - Q_{DA}) \times \$_{RT}$
{-80 - (-100)} x $60 = $1200

RT Component	Total
Energy Payment	$1200
Bid Cost	$6000
RT Make-Whole	$4800

*Assumes Actual Consumption = RT Dispatch

Observation:

- It is paid $1200 in the RT balancing market for the 20MW not consumed in real-time.
- It receives a RT make-whole payment that makes up for the lost value of consumption of $4800 by following dispatch to 80 MW.

Scenario 1: Net Settlement

Net Component	Net Settlement
DAM Energy	-$2000
DAM Make-Whole	$0
RT Balancing	$1200
RT Make-Whole	$4800
Total	**$4000**

Net Profit (Total Net Settlement – Total Net Cost)
$4000 - (-$84000) = $88000

Conclusion:

- The net settlement yields to a payment of $4000.
- Real-time make-whole payment makes up for the lost value of consumption when the load is dispatched down uneconomically.
- Without interaction of DAM make-whole, real-time make-whole properly preserve the resource's incentive to follow dispatch.
- The load is not worse off financially for following IESO dispatch instructions.

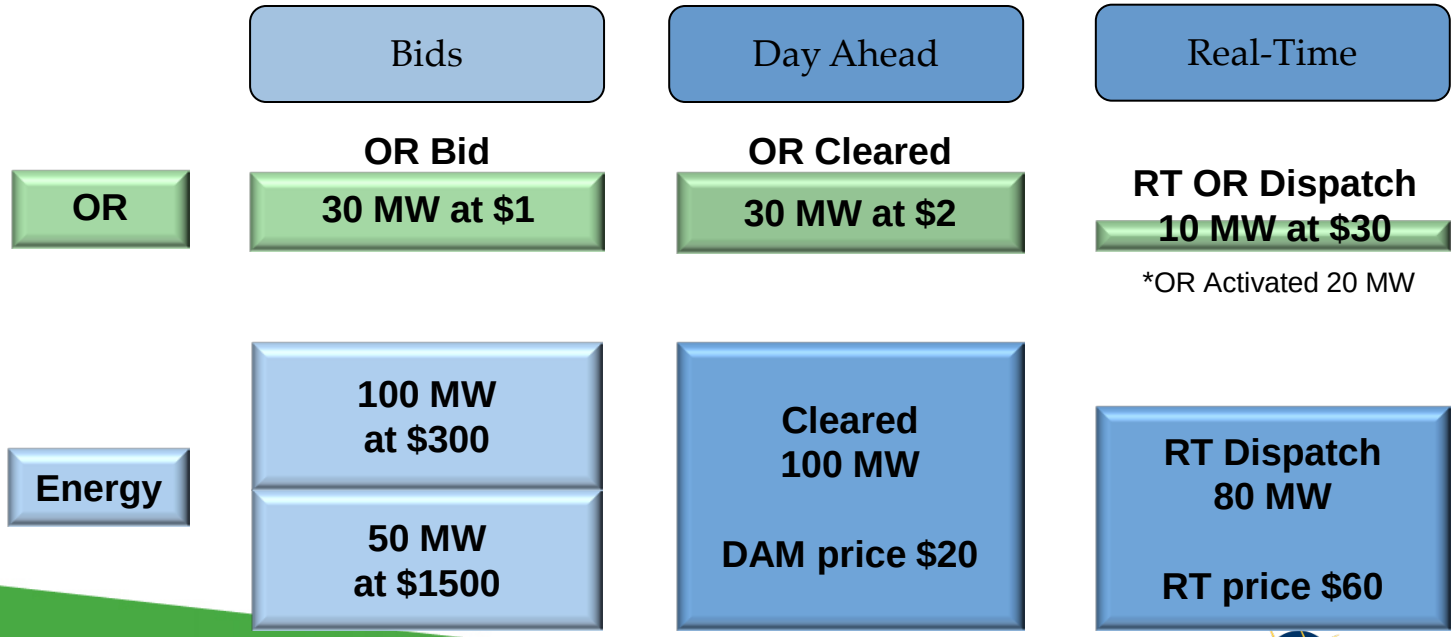
Scenario 2: OR Participation and Activation

Scenario 2: shows a load scheduled both in energy and OR market and receives a RT make-whole payment for OR activation.

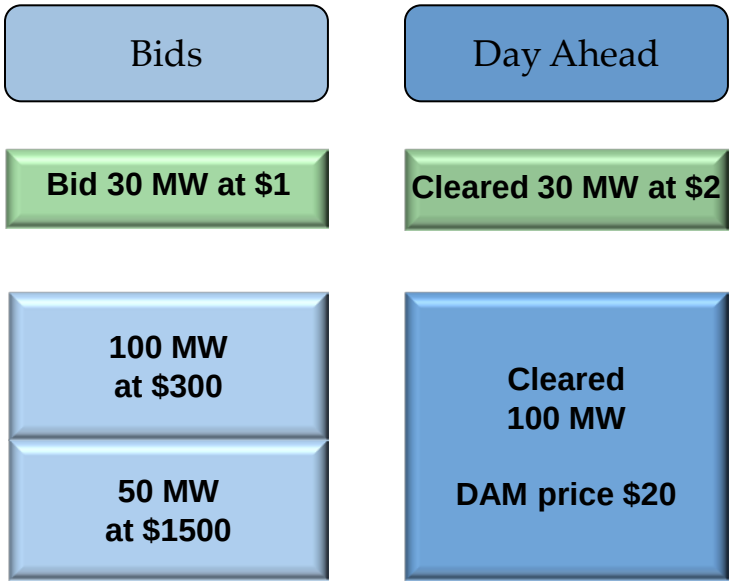
Scenario 2: OR Participation and Activation

Day-Ahead: The load is scheduled economically at 100 MW for energy at a price of $20 and 30 MW for OR at a price of $2.

Real-Time: The load is activated for 20 MW of OR and is dispatched down to 80 MW for energy and 10 MW for OR. The RT energy price is $60 and OR price $30.



Scenario 2: Settlement in DAM

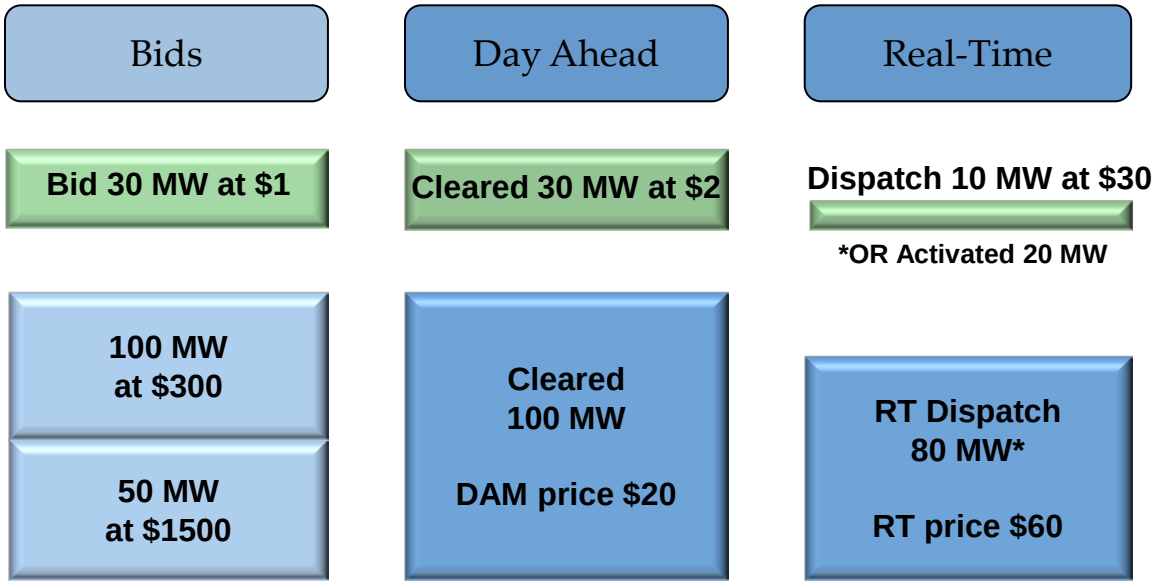


DAM	OR	Energy
DAM Rev/Cost	$60	-$2000
DAM Bid Cost	$30	-$90000
DAM Make Whole	$0+$0 = $0	
DAM Settlement	$60-$2000 = -$1940	

Observation:

- Load is charged with a energy cost of -$2000
- Load is paid an OR revenue of $60
- No DAM make whole because the combined DAM energy charge and OR revenue is lower than combined cost of consumption implied by the load's energy and OR bids.

Scenario 2: Settlement in Real-Time



*Assumes Actual Consumption = RT Dispatch

RT Balancing Settlement (OR + Energy)		
-$600+$1200= $600		
RT	**OR**	**Energy**
Revenue	-$600	$1200
Cost	-$20	$6000
RT Make-Whole	$580+$4800=$5380	

Observation:

- It is paid $1200 for the 20 MW of energy not consumed in RT.
- It buys back the 20 MW of OR schedule at a total charge of -$600.
- It receives a RT make-whole of $5380 for being dispatched down uneconomically in both the energy and OR market.

Scenario 2: Net Settlement

Net Component	Net Settlement
DAM Energy	-$1940
DAM Make-Whole	$0
RT Balancing	$600
RT Make-Whole	$5380
Total	**$4040**

Net Profit (Total Net Settlement – Total Net Cost)
$4040 - (-$83990) = $88030

Conclusion:

- The net settlement yields to a payment of $4040.
- RT make-whole payment needs to consider the revenue/cost in both energy and OR market and makes up for the net loss in both markets.
- The load is not worse off financially for following IESO dispatch instructions.

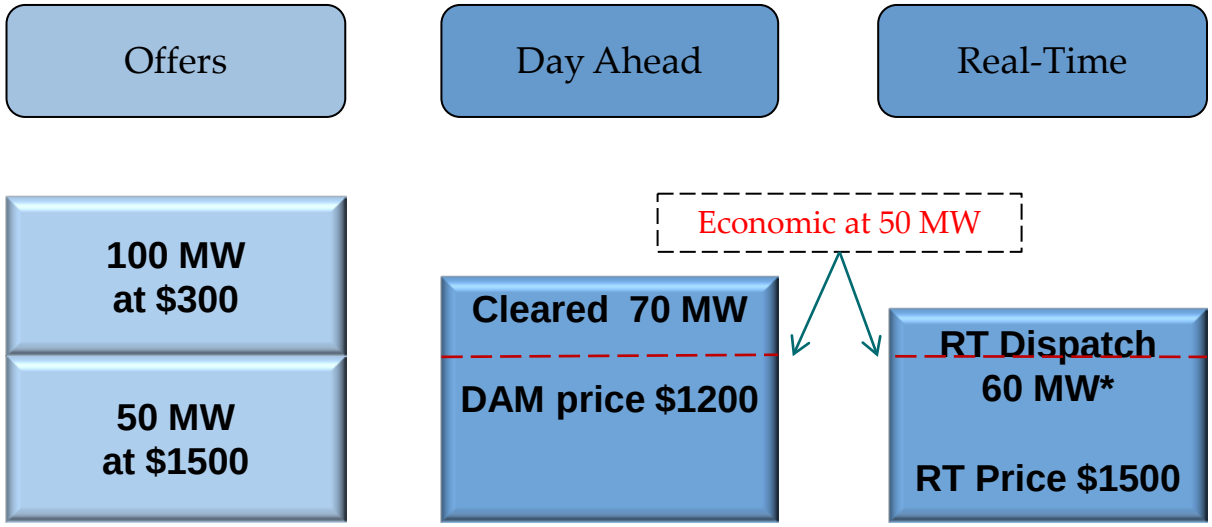
Scenario 3: Load constrained-up in DAM & constrained-up in RT

Scenario 3: shows a load that is constrained-on in both DAM and RT uneconomically and receives a make-whole payment in both timeframes.

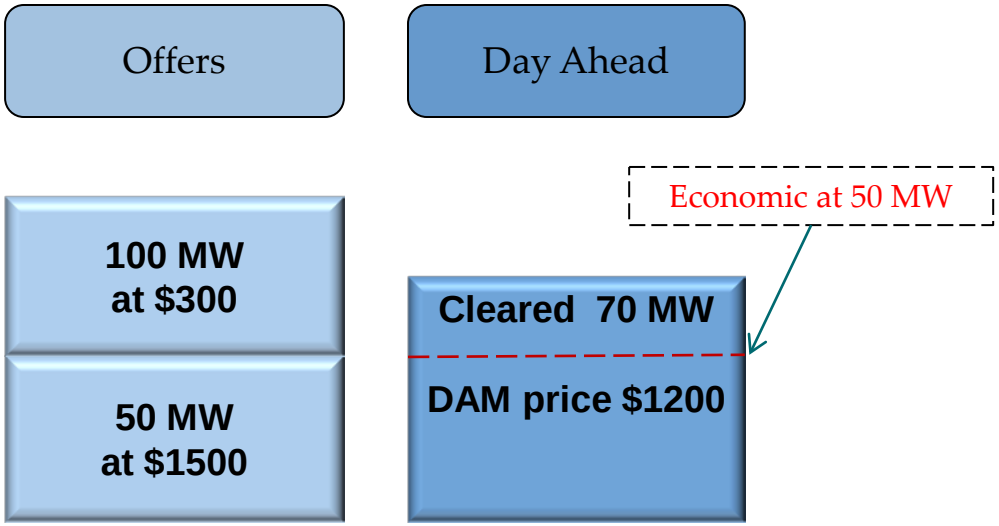
Scenario 3: Load constrained-up in DAM & constrained-up in RT

Day-Ahead: The load is constrained-up to 70 MW above its economic point of 50 MW at a price of $1200

Real-Time: The load is constrained-up to 60 MW above its economic point of 50 MW at a price of $1500



Scenario 3: Settlement in DAM

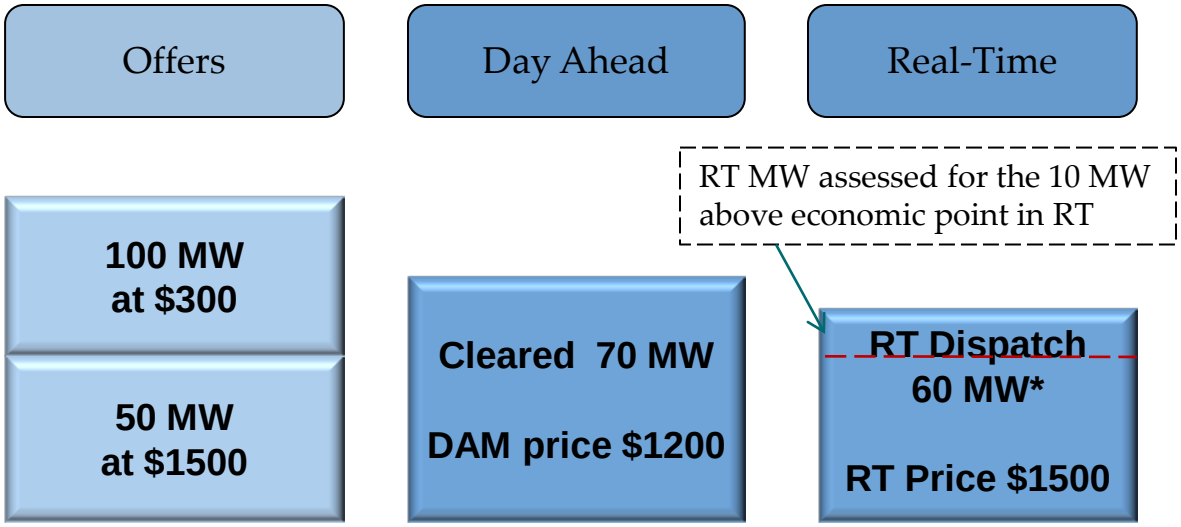


DAM Component	Total
DAM Energy Charge	-$84000
DAM Bid Costs	-$81000
DAM Make-Whole	$3000
DAM Settlement	-$81000

Observation:

- Load is charged with a energy cost of -$84000.
- Load also receives a DAM make-whole payment of $3000 to cover its additional cost for consuming 20 MW of energy above its economic point.
- Total DAM settlement is -$81000.

Scenario 3: Settlement in Real-Time



*Assumes Actual Consumption= RT Dispatch

RT Balancing Settlement
$(Q_{RT} - Q_{DA}) \times \$_{RT}$

{-60 - (-70)} x $1500 = $15000

RT Component	Total
Energy Charge	-$15000
Bid Costs	-$3000
RT Make-Whole	$12000

Observation:

- It is paid $15000 for the 10 MW of DAM schedule not consumed in RT.
- It receives a RT make-whole payment of $12000 for consuming 10 MW of energy above its economic point.

Scenario 3: Net Settlement

Net Component	Net Settlement
DAM Energy	-$84000
DAM Make-Whole	$3000
RT Balancing	$15000
RT Make-Whole	$12000
Total	**-$54000**

Net Profit (Net Settlement – Net Cost)
-$54000 - (-$78000) = $24000

Conclusion:

- The cost of consuming additional 10 MW constrained-on energy in RT is already covered by the DAM make-whole payment.
- Providing a RT make-whole payment results in the load being paid twice for consuming 10 MW constrained-on energy in RT.
- RT make-whole payments should take into account interactions between DAM and RT make-whole payments to avoid over compensation.

B. MAKE WHOLE PAYMENT GUIDELINES

Design Considerations

- It would be impractical to identify how the real-time make whole payment would be applied for all possible two-settlement scenarios during high level design

- IESO is proposing real-time make whole payment guidelines that will be used to inform all of the real-time make-whole payment calculations during detailed design.

- The guidelines were determined by reviewing treatment of make whole payments for constrained events in other jurisdictions and applying them where appropriate in Ontario market.

Real-Time Make-Whole Payment Guidelines for Energy and Operating Reserve

Guideline		Rationale
1	When not scheduled in DAM: • RT make-whole payments should bring the resource back to its operating profit for constrained-down events. • RT make-whole payment should bring the resource back to its operating cost for constrained-up events.	Provides correct incentive for resources to follow IESO dispatch instructions even if they are dispatched to a less economic position.

Real-Time Make-Whole Payment Guidelines for Energy and Operating Reserve (con't)

Guideline		Rationale
2	When scheduled in DAM, RT make-whole payments should take into account interactions between DAM and RT make-whole payments.	Avoid make-whole payments that result in overpayment and create unnecessary uplifts.
3	RT make-whole payment should not cover resource costs when a resource deviates from dispatch instructions for situations within its own control (e.g. derate, testing equipment).	Prevents market participants from benefiting from their own non-compliance with dispatch instructions.

Real-Time Make-Whole Payment Guidelines for Energy and Operating Reserve (con't)

Guideline		Rationale
4	RT make-whole payment should consider any real-time balancing revenues gained and costs incurred for operating reserve.	• Unless exceptions are required to ensure a resource remains incentivized to follow its dispatch, including balancing revenues and costs for operating reserve avoids over or under compensation.

MAKE WHOLE PAYMENTS – TREATMENT OF NQS RAMP IN DAM

Recap from the May Meeting

- During the May meeting, a discussion about make whole payments and uplift prompted the IESO to look into whether efficiency gains could be realized if NQS resources received a financially binding schedule for their ramp up hours

- If NQS resources do not receive a financially binding DAM schedule for its ramp, other resources would be scheduled in lieu of the NQS ramp energy in order to balance load in the DAM.

Design Considerations

- If nothing changed between the DAM and real-time and the NQS ramp materialized in real-time, real-time prices would be lower than DAM prices.

- Consistent price differences between DAM and real-time could reduce the efficiency of bids and offers into the DAM, which could lead to a less efficient unit commitment

- An additional NQS resource could also be over-committed in the DAM if the sum of ramping energy not modeled were large, increasing the potential for uplift

Status in other Jurisdictions

- Other jurisdictions do not produce financially binding schedules for NQS ramp up because the efficiency benefits do not appear to outweigh the administration costs
  - Other jurisdictions do not have many NQS resources with long start-up times, so risk of unit over-commitment is low
  - DAM performance might suffer because additional ramp parameters would need to be evaluated in order to produce predictable NQS ramp schedules

Preliminary Decision and Rationale

Preliminary Decisions	Rationale
Include ramping energy in a NQS resource's financially binding DAM schedule.	• Supports greater price convergence between DAM and real-time by aligning DAM scheduling outcomes with real-time expectations, given Ontario has a higher penetration of NQS resources relative to other jurisdictions. • Reduces the potential for increased uplift due to over-commitment of additional NQS resources in the DAM.

- Note that inclusion of financially binding ramp schedules result in additional DAM revenues that will impact the DAM make-whole payment calculation for NQS resources.

Detailed Design Considerations

- The IESO will bring forward the preliminary decision for vendor consultation during detailed design and proceed with implementation if evaluating additional ramp profile parameters does not:
  - Prevent the DAM from executing within the proposed execution time of 3.5 hours; and
  - Come at a significant implementation cost such that other higher priority software improvements could be placed at risk

RECAP AND NEXT STEPS

Summary of Preliminary Decisions

- IESO moving to zonal demand forecasting
- HDR bids into the DAM will be exposed to two-settlement
- Multiple software requirements are being proposed to provide hydro-electric resources with feasible DAM and pre-dispatch schedules
- Real-time make whole payments guidelines will ensure resources are being appropriately compensated and incentivized to follow their real-time dispatches
- NQS resources will receive financially binding DAM ramp schedules

Next Steps

- Feedback on preliminary decisions requested by October 18, 2018.
- There are no further preliminary decisions required for high level design
- November meeting may be required to address any outstanding stakeholder feedback on preliminary decisions
- Delivery of the high level design is scheduled for the end of the year.