Market Renewal Program: Enhanced Real-time Unit Commitment (ERUC)

Stakeholder Meeting July 19, 2018

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Note on 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, and are intended to facilitate progress on design elements which will be finalized in the High Level Design document

Today's Agenda

- **Meeting Objectives & Expectations**
- **ERUC Work Stream Recap**
- **Clarification on make-whole payments**
- **Design Elements**
  - Remaining Preliminary Decisions (2)
  - Stakeholder Feedback and IESO responses
- **Next Steps**

Meeting Objectives & Expectations

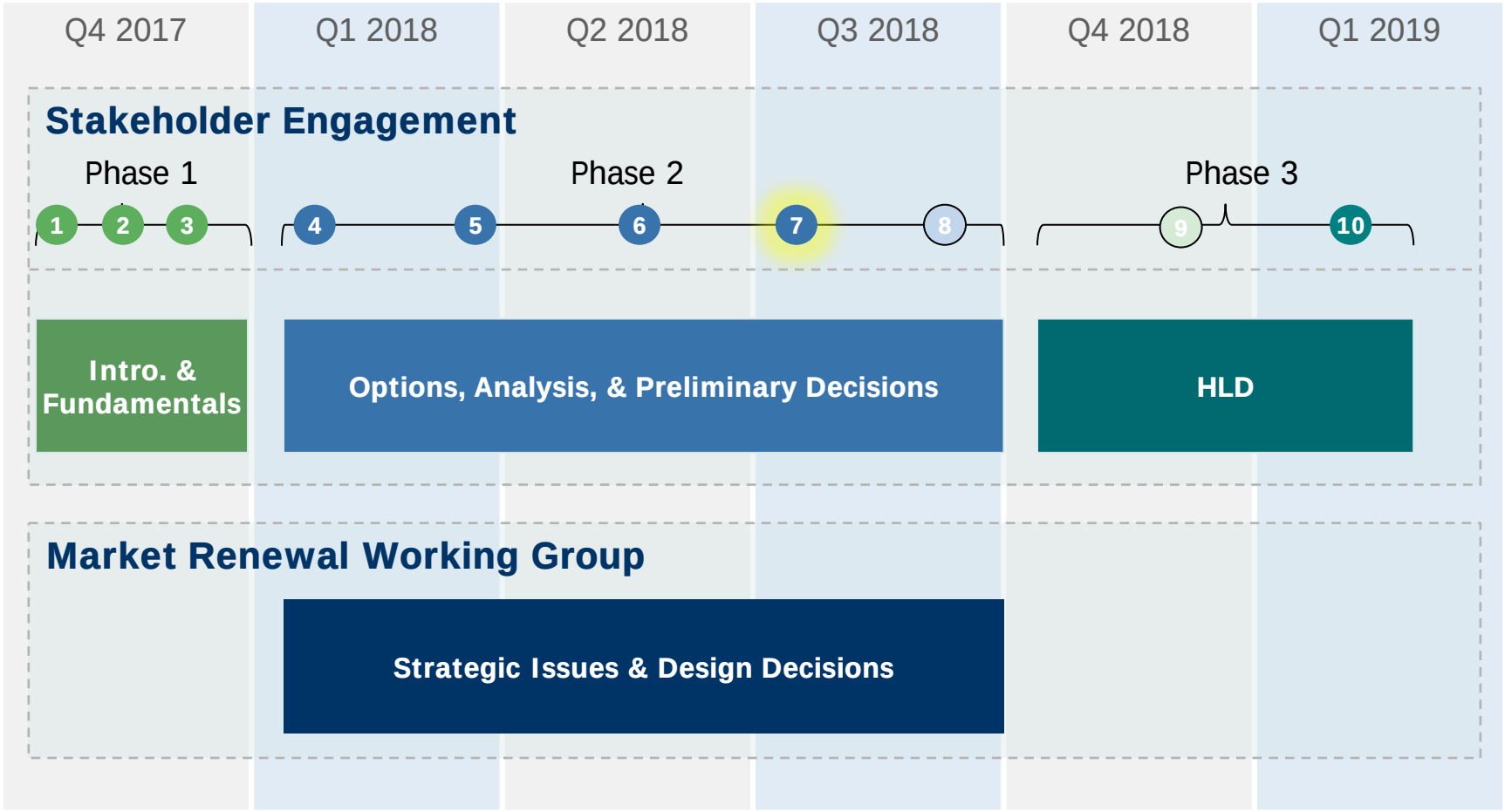
- The IESO will be presenting two preliminary decisions as well as responses to stakeholder feedback today:
  - Decisions: DE3 Timing and Frequency & DE10 Offer Changes
  - Stakeholder Feedback and IESO Responses:
    - DE2 Look-Ahead Period
    - DE3 Timing and Frequency
    - DE5 Intertie Transactions
    - DE8 Market Participant Data
    - DE12 Calculation of Cost Guarantee
    - DE13 Failure Charge
- Stakeholders are invited to use meeting time to discuss preliminary decisions and IESO responses to feedback
- Additional written stakeholder feedback requested by **August 17**, 2018

Recap – ERUC Project Purpose

1. Design a security constrained pre-dispatch (PD) model jointly optimizing energy and operating reserves over the look-ahead period based on most recent IESO forecast data
2. Consider all resource offers to determine optimal mix – all generation resources, loads, intertie transactions
3. Provide advisory schedules and advisory prices for all resources
4. Apply an operational constraint for eligible resources* if they are lowest cost

*Resources eligible for an operational constraint are generators that take a long time to start-up, and must stay online for a min. number of hours at a min. injection level for equipment reasons.

ERUC Project Timeline for High Level Design



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Design Elements for Discussion

Module	Module Name	#	Design Element	Preliminary Decisions	
				Primary	Secondary
A	Engine Parameters	1	Functional Passes	Complete	N/A
		2	Look-Ahead Period	Complete	N/A
		3	**Timing and Frequency of Run**	Complete	**Today**
		4	Time Step	Complete	N/A
B	Participation & Input Data	5	Intertie Transactions	Complete	Complete
		6	Offer Obligations/Reference Quantity	Today (DAM)	N/A
		7	Eligibility for Cost Guarantee	Complete	N/A
		8	Market Participant Data	Complete	Complete
C	Market Power Mitigation	9	Commitment Cost Mitigation	Complete	Complete
		10	**Offer Changes**	Complete	**Today**
D	Output of Engine	11	Binding Start-up Instruction & Operational Constraint	Complete	Complete
E	Settlements	12	Calculation of Cost Guarantee	Complete	Complete
		13	Failure Charge	Complete	Complete

Clarification on Make-whole Payments

- To date, we have discussed 3 types of make-whole payments that will be required
  - DAM Make-whole payment
  - PD Make-whole payment
  - RT Make-whole payment

- Both the DAM make-whole and RT make-whole are available to all dispatchable resources including generators, loads and intertie transactions, whereas the PD make-whole is available only to eligible resources

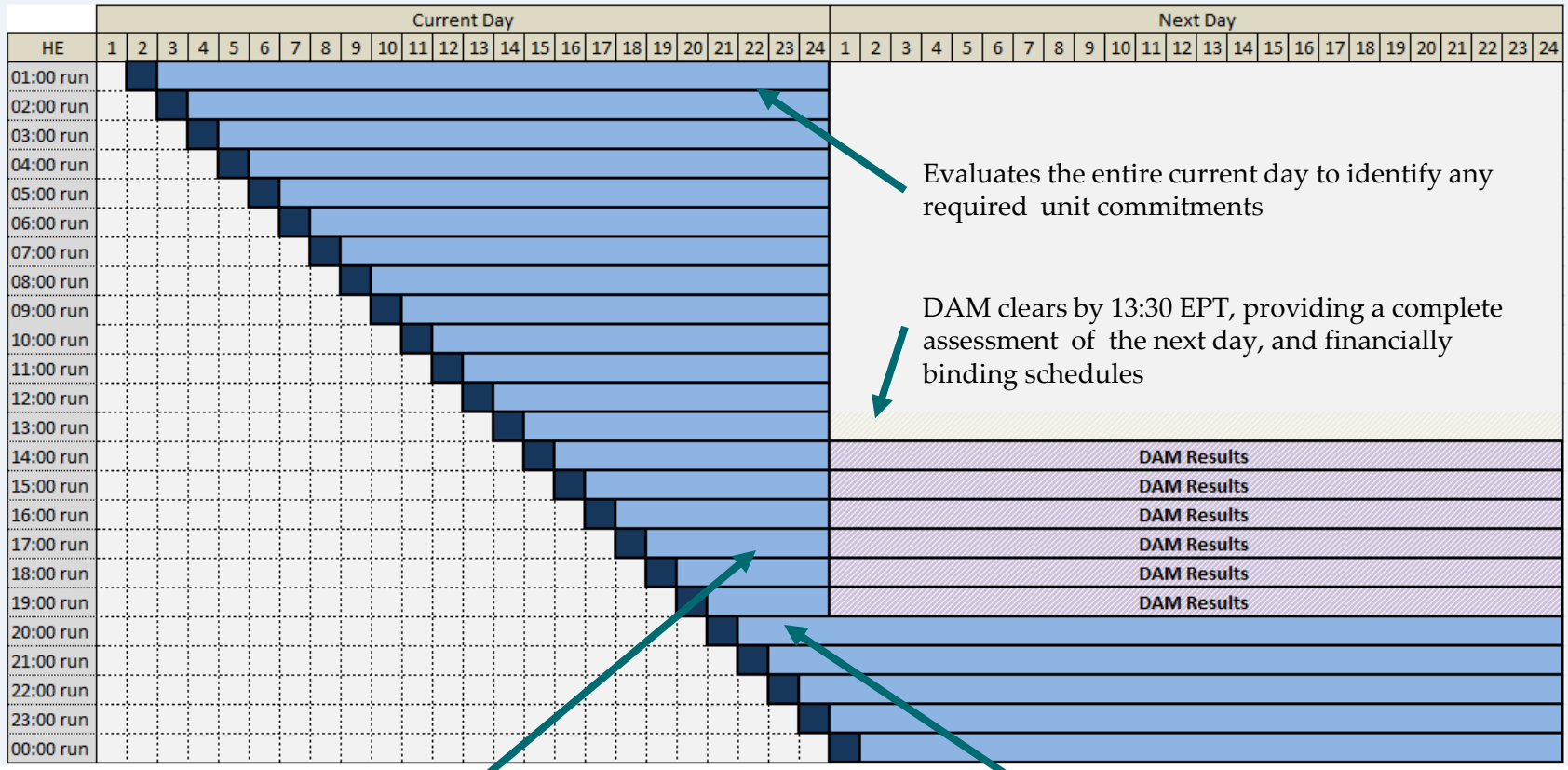
Clarification on Make-whole Payments

- The DAM make-whole will compensate resources with a financially binding schedule for recoverable costs when DAM revenues are less than DAM as-offered costs
- The RT make-whole is intended to compensate resources dispatched out of merit, that is, constrained up or constrained down uneconomically
- The PD make-whole will compensate NQS generators that have a registered MGBRT, MLP and elapsed time to dispatch > 1 hour for recoverable costs when RT revenues are less than RT as-offered costs

- In order to differentiate between make-whole payments that apply to all resources versus the cost guarantee for NQS generators, in future we will refer to the PD make-whole as the **Cost Guarantee**

DESIGN ELEMENT NO. 2: LOOK-AHEAD PERIOD

Recap – Preliminary Decision



Stakeholder Feedback & Response

Feedback: The IESO should reconsider moving the first PD run including hours of the next day to an earlier time, as the 20:00 timeline only allows participants two opportunities to review and update its next day offers prior to closure of the mandatory window for HE1; recommend that the next day be included in the first PD run following the DAM published results but no later than the 18:00 run

Response: Four options were considered

1. Increase maximum LAP to 29 hours
   - Software capabilities may not be sufficient to manage a longer LAP while also running with hourly frequency, three part offers and multi hour optimization, market power mitigation, modelling of combined cycle and energy limited resources

IESO Response Cont'd.

2. Beginning at 18:00, run PD with a 27 hour LAP starting HE20 (T+1)
   - PD would not evaluate up to HE 24 of the next day for the first two runs; creates issues for scheduling energy-limited resources that provide a 24-hour Daily Energy Limit

3. Beginning at 18:00, run PD with a 27 hour LAP starting HE22 (T+3)
   - Under this scenario, the 17:00 PD is the last run of the day that evaluates HE 20 and HE 21 of the current day, impacting intertie scheduling and extensions for those hours

4. Split PD into two runs at 18:00 and 19:00
   - Run 1 evaluates the rest of the current day; Run 2 evaluates HE22 until the end of the next day (27 hour LAP), using results from Run 1 to initialize
   - Results would likely be inconsistent in overlapping period
   - Software capabilities may still prevent hourly frequency PD runs

IESO Response

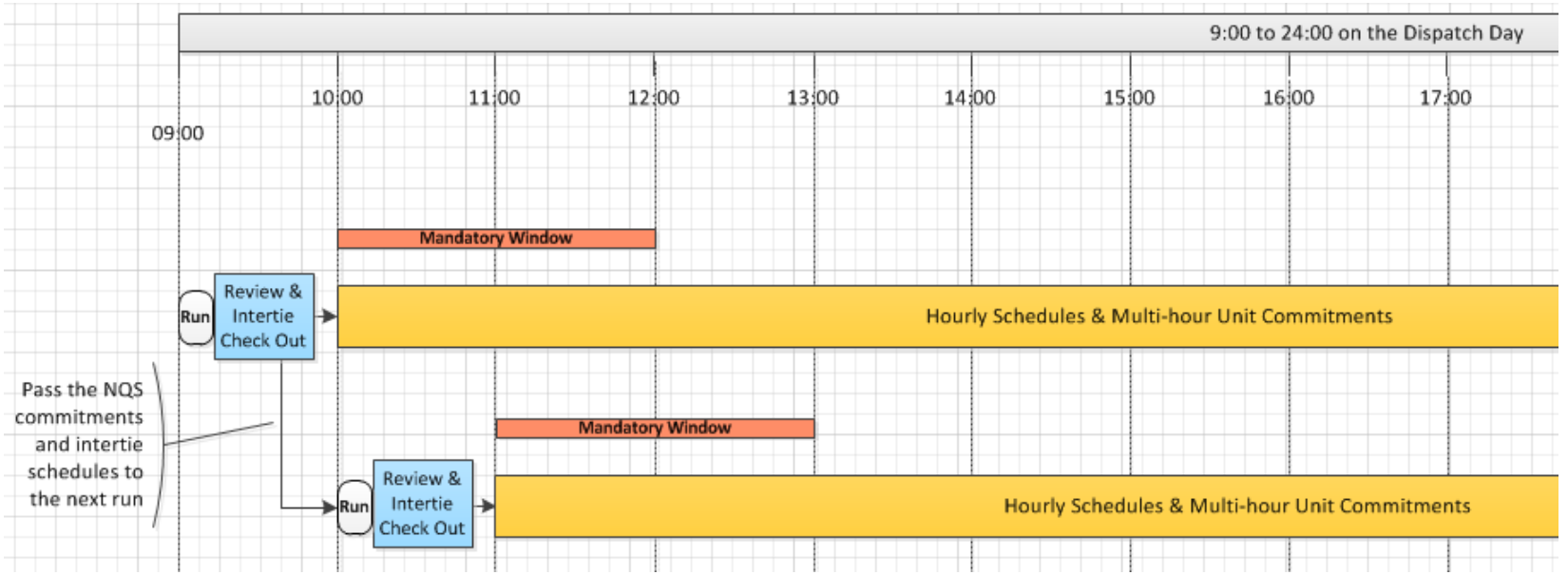
None of these options is workable. The IESO proposes maintaining 20:00 as the first run that includes hours of the next day, bridging current and next day, noting that:

- DAM is expected to result in greater and more efficient participation that will increase DA and PD certainty compared to today's DACP
- The enhanced PD, utilizing the same multi-hour optimization and resource modeling as DAM, is expected to increase the likelihood DAM schedules will be maintained but also improve the ability to adjust schedules due to changes in conditions
- Therefore IESO believes the 20:00 timeframe will, in the future, be adequate for market participants to plan for the next day

DESIGN ELEMENT NO. 3: TIMING AND FREQUENCY OF RUNS

Recap – Preliminary Decisions from DE3 Timing & Frequency

- T+1 & T+2 published by 15 minutes past hour
- All hours published by 30 minutes past hour
- Hourly run frequency



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Stakeholder Feedback & IESO Response

Feedback: The IESO has indicated that schedules will be published no later than 15 minutes past the hour, so a generator will only receive 45-minutes notice to shut down, making it difficult for some facilities to complete the shutdown sequence; generators need to be able to signal when they need to come off-line without being unduly mitigated and/or forced to operate when they have limitations

Response: Generators may offer at higher prices to indicate intent to come offline, and offers will be assessed for market power

- If the generator does not have market power, the offer will not be mitigated and the generator will be able to ramp down
- If the generator has market power and the offer is mitigated, the generator may continue to operate, if able, or may submit outage or de-rate information if not able to continue operating

Stakeholder Feedback & IESO Response

Feedback: Stakeholders need clarification as to how MPM is expected to work alongside shutdown offers

Response: Conduct thresholds provide safe harbours for raising offer prices above the reference price

- Offering within the safe harbours will prevent mitigation, and even if offers violate the conduct threshold, they will not be mitigated if there is no impact on price
- The IESO will work with participants to set reference levels in detailed design

Secondary Preliminary Decision

- Actions may be required by the IESO in the case of significant changes in system conditions during the timeframe between publishing of DAM results at 13:30 EPT and the first run extending into next day at 20:00
- In the event of a significant change in system conditions:

IESO Recommendation	Rationale
• The IESO may evaluate whether additional operational commitments are needed • Operational commitments will be issued, if required, subject to a resource's submitted lead time	Reliability: Need to ensure sufficient resources are available/committed for next day in the event of significant system condition changes between when DAM clears and when PD starts looking at next day's schedules (20:00 of current day)

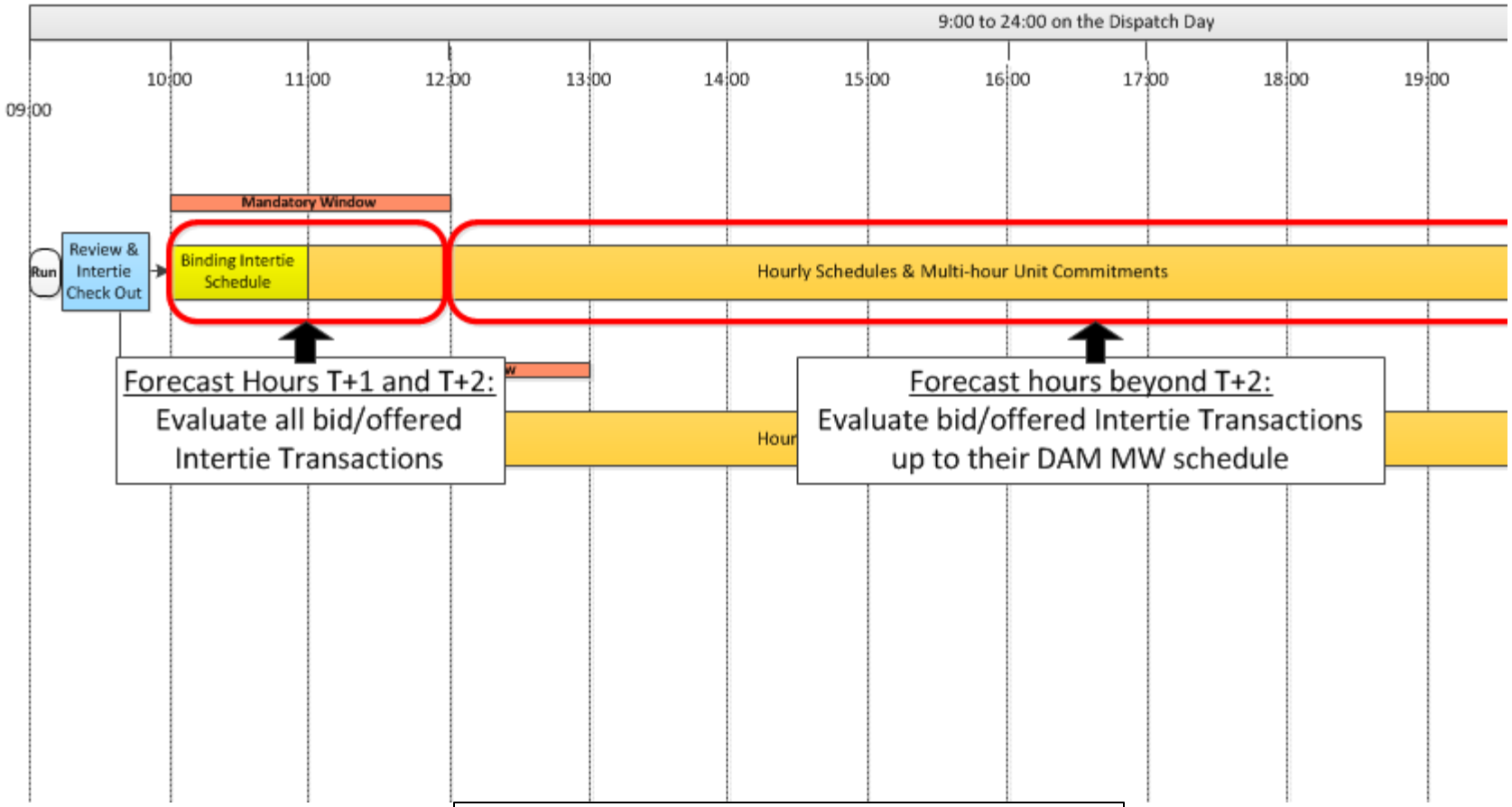
DESIGN ELEMENT NO. 5: INTERTIE TRANSACTIONS

Recap – Intertie Transactions

- Addresses whether the PD runs will consider intertie bids and offers that do not have a DAM schedule

- In order to optimize efficiency of commitments and maintain reliability when looking ahead multiple hours, we need to address treatment for non-DAM intertie bids/offers which may not be available in RT

Recap – Preliminary Decision - Option 3



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Stakeholder Feedback & IESO Response

Feedback: Limiting the evaluation of intertie transactions beyond T+2 to the DAM schedule could result in inefficient scheduling because intertie flows follow RT market signals more than DA schedules

Response:

- Intertie transaction have the opportunity to participate in RT in T+1 and T+2, so RT market signals will be addressed
- The limitation is based on the assumption that DAM transactions, being financially binding, have a higher degree of certainty to flow in RT than non-DAM intertie bids/offers
- The IESO is aware of potential efficiency impacts, but must balance efficiency & reliability

Stakeholder Feedback & IESO Response

Feedback: Limiting the evaluation of intertie transactions beyond T+2 to the DAM schedule doesn't reflect the DAM results in other jurisdictions, which may be different

Response:

- We will include the DAM schedules of other jurisdictions that don't have corresponding Ontario DAM schedules during T+1 and T+2 only
- Transactions scheduled in the Ontario DAM are more certain to flow in RT because the IESO will perform DAM checkout in order to assess the certainty of the transactions
- Transactions scheduled in the DAM of another jurisdiction but not in Ontario's DAM are therefore less certain

Stakeholder Feedback & IESO Response

Feedback: Limiting the evaluation of intertie transactions beyond T+2 to the DAM schedule could result in differences in advisory prices closer to RT, leading to inefficiency/higher cost

Response:

- The IESO agrees that PD advisory price signals in T+3 and beyond may be less accurate than 2 hours before RT due to limiting the transactions considered
- This is acceptable because the IESO needs to maintain reliability, and including non-DAM transactions in T+3 and beyond could also cause inaccurate price signals if they do not flow in RT, impacting efficiency/cost and also impacting system reliability

Stakeholder Feedback & IESO Response

Feedback: Rather than limiting the evaluation of intertie transactions beyond T+2 to the DAM schedule, the IESO should forecast the intertie flows beyond T+2; this would align schedules more closely with reality versus outdated DAM schedules

Response:

- It is not appropriate to forecast non-binding intertie transactions because past realized quantities may not be indicative of future quantities
- DAM schedules will provide appropriate incentives for intertie transactions, based on system conditions

Stakeholder Feedback & Responses

Feedback: The IESO could look at how other markets using forecasted prices, such as NYISO, evaluate intertie flows prior to schedules.

Response:

- Jurisdictions like New York and Michigan look ahead only a few hours, limiting the impact of non-binding transactions
- SPP, which has a longer look-ahead period similar to the IESO design, does not consider non-DAM intertie transactions in its intra-day flows

DESIGN ELEMENT NO. 8: MARKET PARTICIPANT DATA

Recap - Primary Preliminary Decision

- Generators currently eligible for PD commitment and cost guarantees will provide three-part offers and operational data
- Operational data must be registered with the IESO during the market registration process and may also be provided as daily generator data (DGD)
- The PD model will consider three-part offers and operating parameters including lead time
- Lead time is the amount of notice a generator needs in order to reach MLP from being offline, and which varies depending on state (e.g. cold, warm, hot)

Stakeholder Feedback & IESO Response

Feedback: The IESO should allow generators to register ability to operate at full-speed no-load (FSNL) up to a maximum number of hours; this would allow the PD model to determine whether it is more efficient to completely shut down a generator and restart later in the day, or request that the generator operate at FSNL between periods of injection to the grid

Response:

- This modelling would be required in DAM and PD for consistency
- There would be additional complexity for the optimization, which may increase computing time

Further stakeholder input is required: Would you operate in FSNL mode? If so, is there a technical time limit at FSNL? What is your lead time to 2nd start while in FSNL? What is your MGBRT for 2nd start?

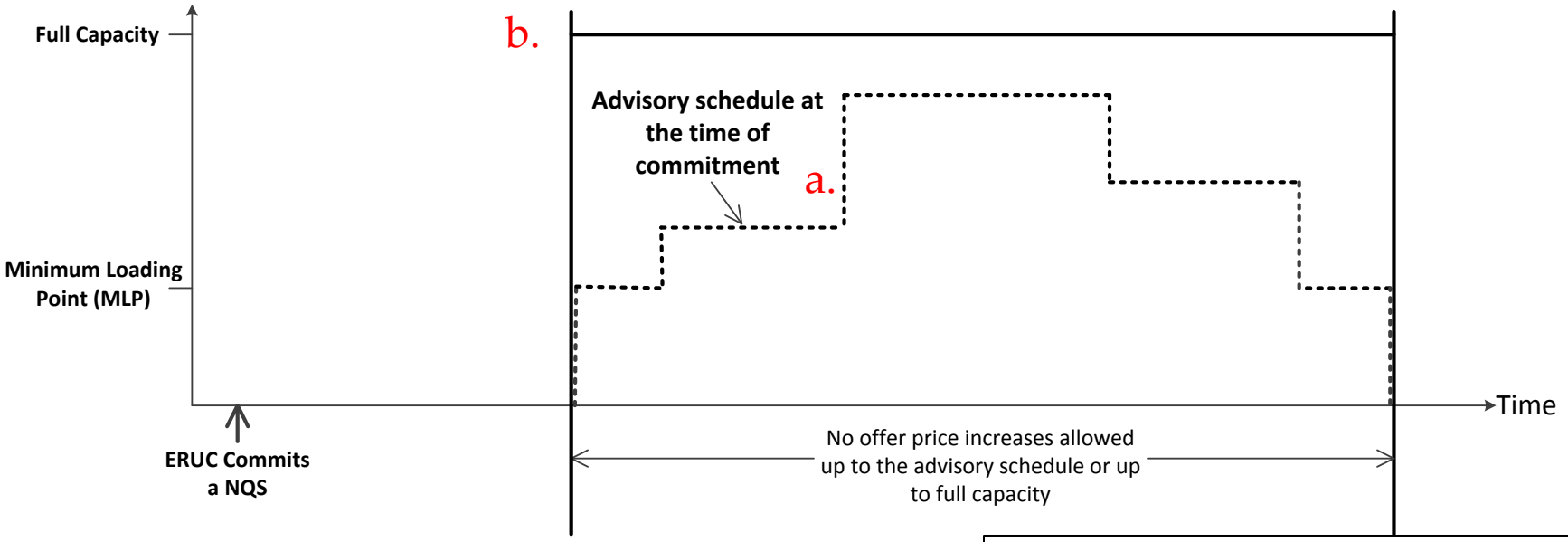
DESIGN ELEMENT NO. 10: OFFER CHANGES

Recap – Offer Changes

- During the period after the DAM clears until real-time dispatch, restrictions apply for:
  - increases in commitment cost offers, incremental energy offers and OR offers
  - changes that make non-price offer parameters more limiting
- Restrictions must be applied to offer changes when a generator has a DAM schedule or a PD commitment in order to limit unwarranted increases in uplift costs and maintain efficiency of commitments
- Primary Preliminary Decision 1: Offer price increases in the energy and operating reserve markets are not allowed for the hours in the advisory schedule when the resource was initially committed by PD
  - **This includes start-up, SNL and energy cost offer prices**

Recap – Secondary Design Consideration

- Need to establish the quantity for the restriction to the energy offer
- Energy offer price increases will be restricted up to:
  a. the advisory schedule quantity provided at the time of the notification of commitment or
  b. the full offered quantity



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Recap – Background

- A NQS generator without a DAM schedule may revise its offers until receiving a PD commitment, providing offer flexibility
- Once commitment is made by the PD model, generators that are marginal will often be the low cost resource up to full capacity compared to commitment of a new resource
  - This provides information that allows the committed resource to influence price and increase its cost guarantee payment
- The resource has a competitive advantage over resources without a commitment, due to sunk start-up costs

Recap – Background (Cont'd)

- Once a generator is committed, the initial PD advisory schedule is less relevant:
  - It will most likely vary in subsequent PD runs due to changing net demand forecast and system conditions
  - During the dispatch hour, committed resources can be dispatched up to the full capacity & down to MLP
  - The cost guarantee for the committed resource is based on its actual real-time production, not the initial advisory schedule

Stakeholder Feedback

Previous Stakeholder Feedback:

- Restrict offer price increases only up to advisory schedule
- Offer price increases should not be automatically prevented because there may be rare occasions where the increase is valid and should be allowed; a process to discuss the reason for the increase with the IESO could be implemented

In May, the IESO requested additional feedback from stakeholders regarding reasons for an offer price increase after a PD commitment.

Stakeholder Feedback & IESO Response

Feedback: There can be significant changes in the intra-day the price of natural gas e.g. polar vortex, therefore offer price increases may be required after PD commitment

Response:

- Due to the competitive advantage of a committed resource that is marginal, there is a need to restrict offer changes up to the full capacity during commitment
- However, the IESO agrees that prices can change significantly during unusual circumstances and this could impact generator costs for quantities above the advisory schedule, requiring flexibility to change the offer price

Stakeholder Feedback & IESO Response

Feedback: There can be changes to the commitment schedule over the day, requiring fuel procurement or additional balancing services, therefore offer price increases may be required after PD commitment

Response:

- The commitment schedule is the RT dispatch schedule during the hours when the resource has an MLP operational constraint
- There will be changes in RT dispatch over the day, but offer price increases will not be allowed due to the competitive advantage of a committed resource that is marginal, except for rare occasions
- The offer price restriction will apply only to the hours of the initial advisory schedule, which the generator will know upon receiving binding start-up instructions, and extension of commitment beyond the initial advisory schedule will restrict changes to the offer price used at the time the extension is made

Stakeholder Feedback & IESO Response

Feedback: There can be changes to the advisory schedule over the day, requiring fuel procurement or additional balancing services, therefore offer price increases may be required after PD commitment

Response:

- Although there can be changes to the advisory schedule over the day, due to the competitive advantage of a committed resource that is marginal, there is a need to restrict offer changes up to the full capacity during commitment
- However, the IESO agrees that prices can change significantly during unusual circumstances and this could impact generator costs for quantities above the advisory schedule, requiring flexibility to change the offer price

Secondary Preliminary Decision

Given the primary decision that offer price increases in the energy and operating reserve markets are not allowed for the hours in the advisory schedule when the resource was initially committed by PD, we have a preliminary decision regarding the quantity to which the restriction would apply, in order to:

- mitigate the exercise of market power by committed resources, and
- address the need to raise offer prices on rare occasions

Preliminary Decision: Offer price increases will be fully restricted and automatically prevented up to the advisory schedule quantity provided at the time the resource was initially committed; above this advisory schedule quantity, offer price increases will be allowed only when the IESO identifies conditions resulting in intra-day volatility

Secondary Preliminary Decision

Rationale: This option mitigates the exercise of market power by committed resources, and addresses the need for generator to raise offer prices on rare occasions

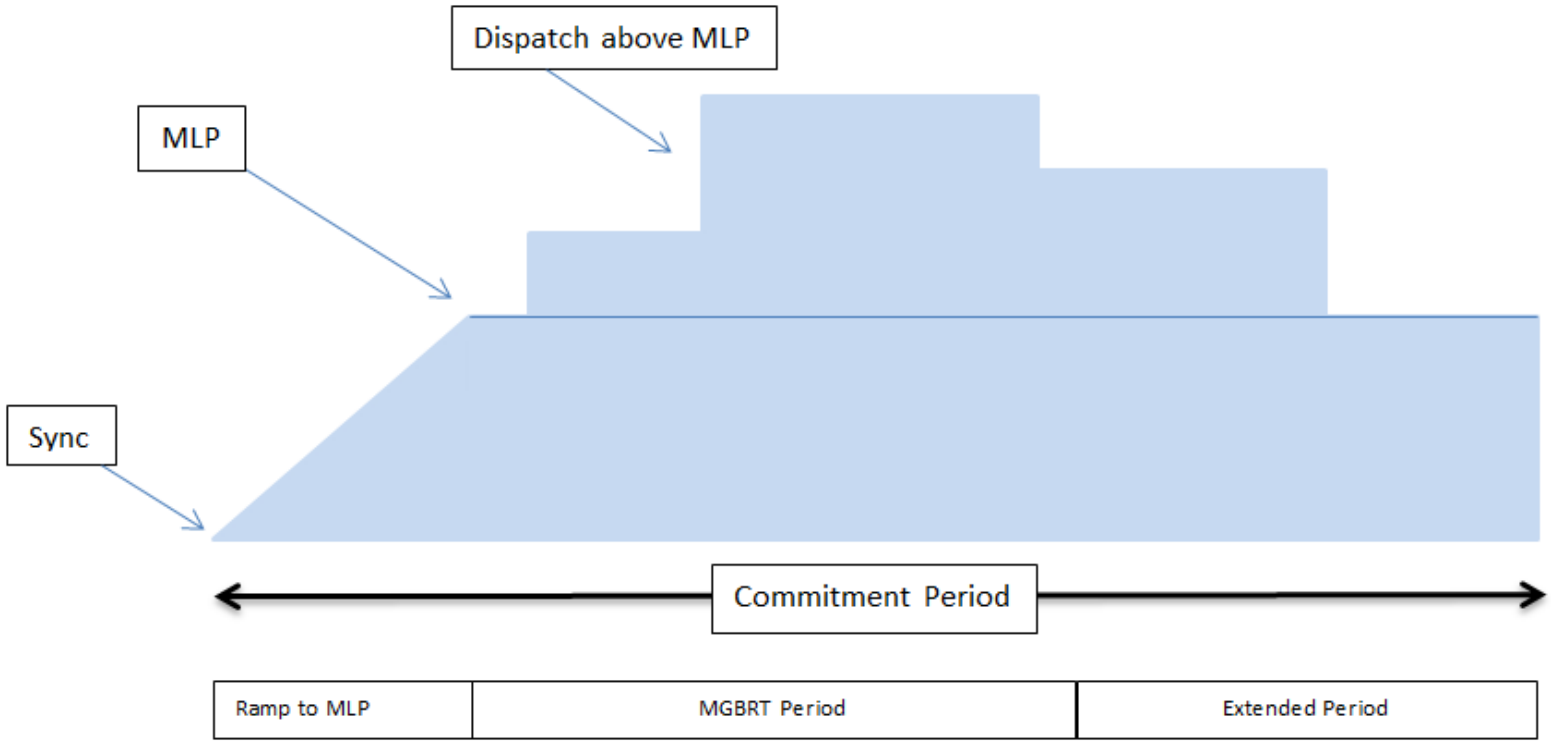
Further information:

- Pre-defined criteria to identify volatile conditions will be established and documented by the IESO, working with market participants during detailed design
- The IESO will provide notification to generators that they may revise prices if required
- The generator must provide evidence for the increase to facilitate ex-post IESO audits and compliance

DESIGN ELEMENT NO. 12: CALCULATION OF COST GUARANTEE

Recap – Preliminary Decision

- Cost guarantee includes all energy and OR revenues, net of all as-offered commitment costs, incremental energy costs and OR costs over the commitment period



Recap – Secondary Decision 1A & 1B – Ineligible Start

1A - A resource will not be assessed for a cost guarantee if it fails to synchronize before the start of its commitment period

1B - A resource will not be assessed for a cost guarantee if it fails to complete its MGBRT

Rationale:

- An additional resource may need to be committed to replace a resource that either fails to synchronize in a timely fashion or that fails to complete its MGBRT
- This may increase uplifts and impact reliability

Question: Ineligible Start

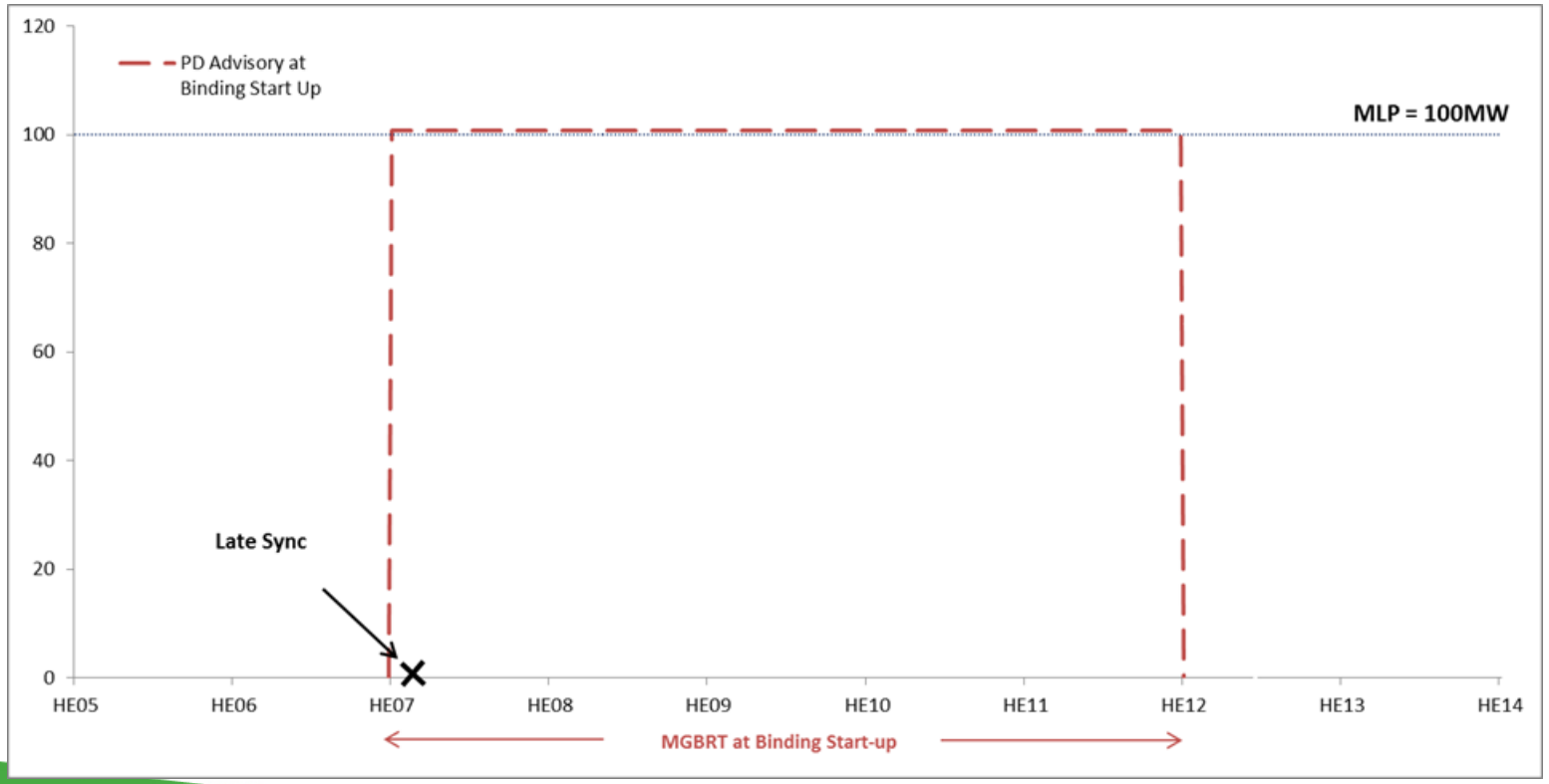
- How will the RT make-whole payment would apply where the resource synchronized late and is ineligible for a cost guarantee?

IESO response:

- The RT make-whole will apply when resources are dispatched out of merit i.e. constrained up uneconomically, if eligible
- A resource that synchronizes late and is constrained up to MLP beyond the original PD operational constraint may not be needed by the system during that additional period
- The eligibility for RT make-whole will not be impacted by this late synchronization generator as long as the advisory schedule at the time of commitment indicates that it was needed

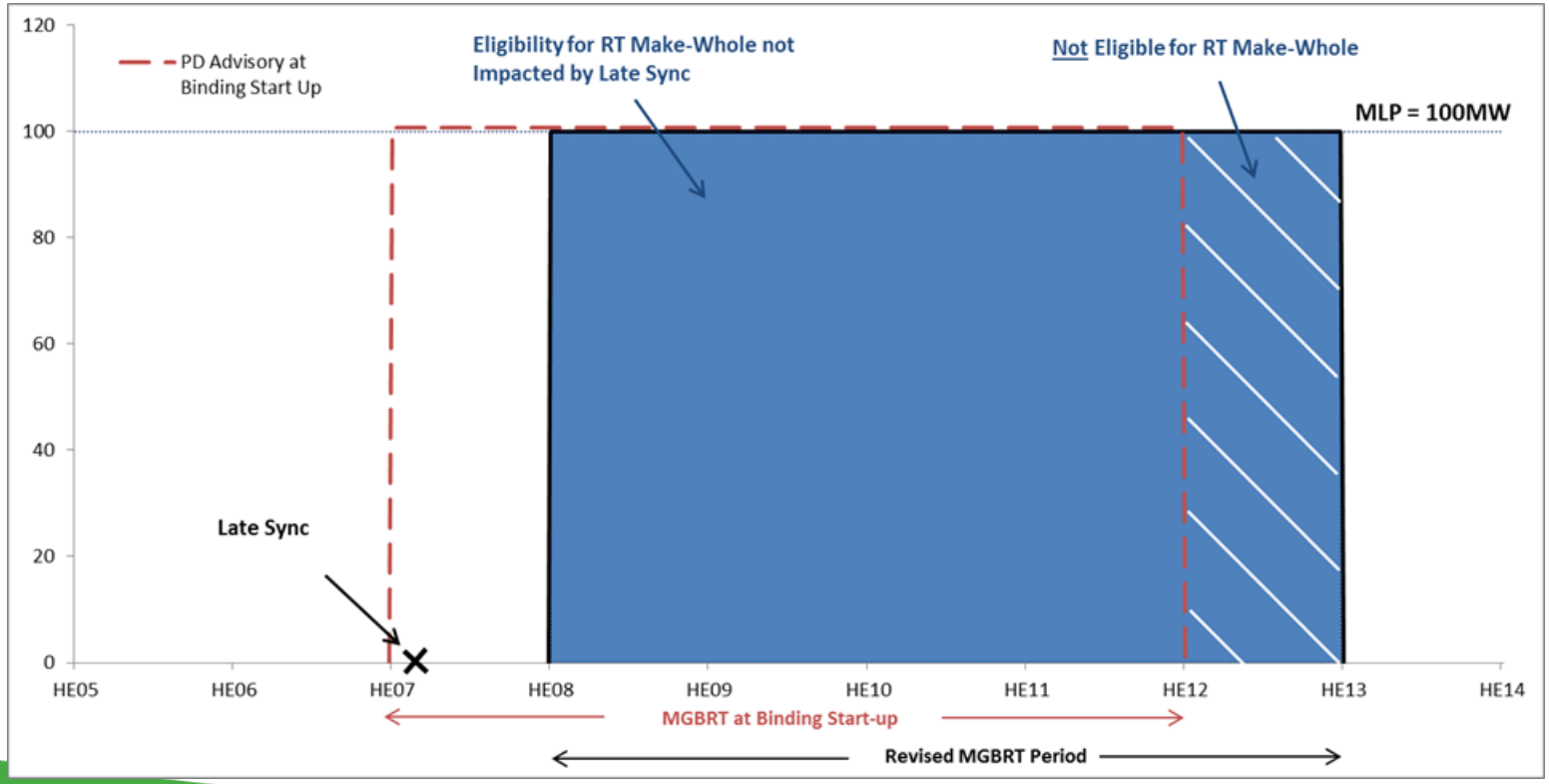
Example: Ineligible Start

- The resource is late to synchronize and is therefore ineligible for the cost guarantee



Example: Ineligible Start

- The eligibility for RT make-whole will not be impacted by late synchronization if the advisory schedule at the time of commitment indicates that it was needed; same for an incomplete MGBRT



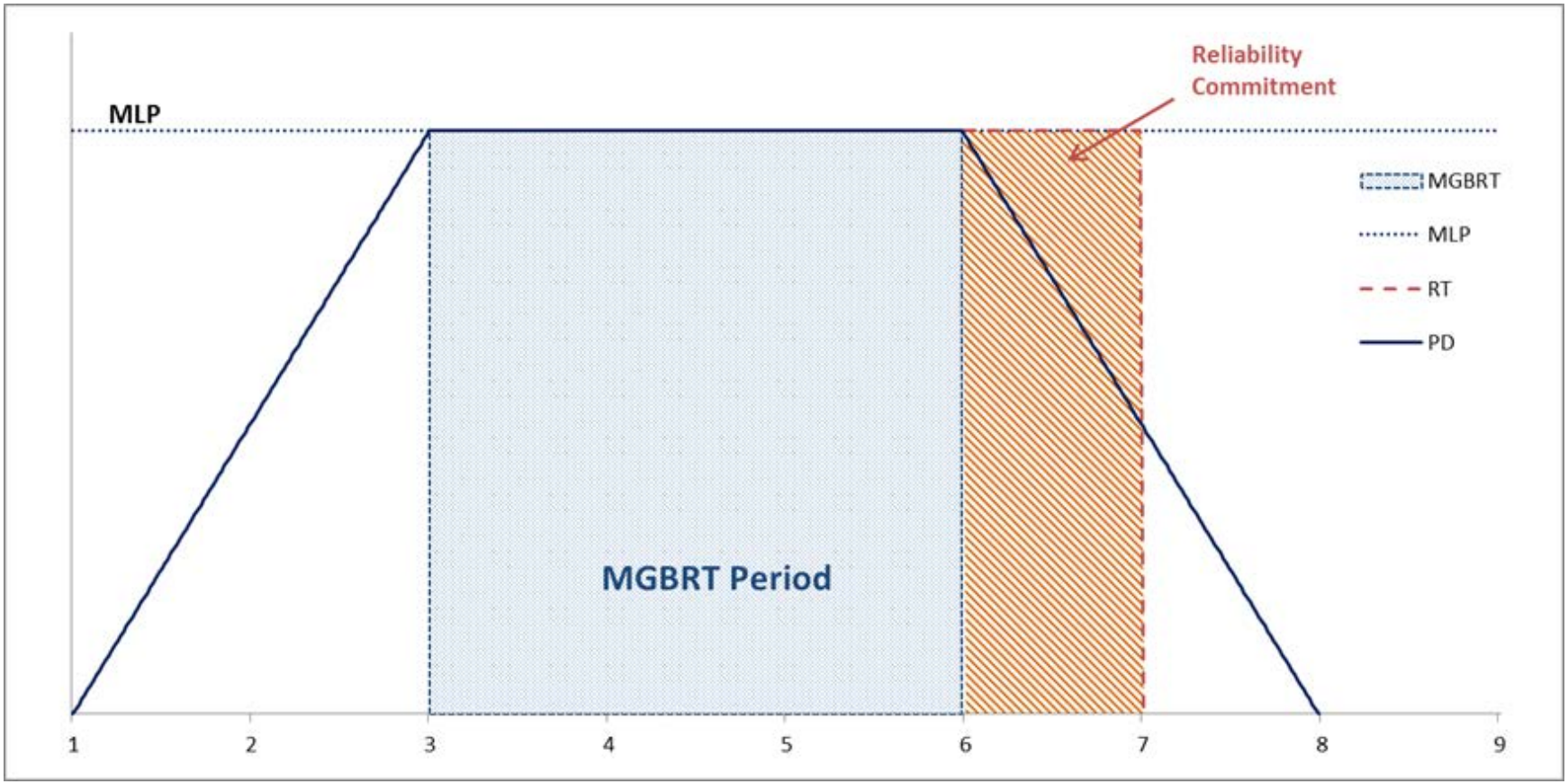
Recap – Secondary Decision 3 – Reliability Commitment

- A resource that is not committed by the PD model but is manually committed by the IESO for reliability reasons will be assessed for a separate cost guarantee for the reliability commitment, even if it is already online under a PD commitment

Rationale:

- If combined for settlement, potential profits from one commitment could reduce cost guarantee payments for another commitment, which could disincentivize a generator from operating when needed by the system

Recap – Secondary Decision 3 – Reliability Commitment



Questions: Reliability Commitment

1. How much notice will be provided if resource is needed for a reliability commitment?
2. How will costs be determined for the cost guarantee?

Overview

The IESO may manually intervene in the routine dispatch process if a review of the output from the dispatch algorithm determines that control actions need to be taken to address events that:

- will have a material impact on the IESO-controlled grid, and
- occur in a timeframe in which the dispatch algorithm and market mechanisms cannot respond

Reliability Commitments – Timing

- Notification timing as well as manual dispatch instruction duration will vary as they are dependent on many factors, including:
  - When the triggering event was identified
  - Characteristics and capability of resources available to respond
- Notification will be provided as soon as a triggering event is identified, which may be any time from DAM clearing to when the generator provides their 5-minute shutdown notice

- The IESO recognizes that a resource that was not extended by PD is expecting to come offline and may not be able to respond to the IESO request to remain online; an outage slip should be provided

Reliability Commitments – Costs

- Costs included in the cost guarantee calculation are based on three-part offers submitted to the IESO, subject to market power mitigation
- Generators may have offered at higher prices to indicate intent to come offline, and offers will be assessed for market power; if no market power, the offer will not be mitigated
- Noting, however, that the conduct threshold will be lower for reliability commitments, even if offers violate the conduct threshold, they will not be mitigated if there is no impact on price
- If mitigated back to the reference price, in the case of a reliability commitment it is very likely that the market price is higher than the reference price, and generators will be compensated accordingly

New: Ramp Cost Considerations

- During ramp up and ramp down, the IESO recognizes that generators may incur costs not recovered through the market price
- Ramp up costs are part of the generator's start-up costs, currently included in the RT-GCG pre-approved cost submission; in future, generators will offer these costs into the market for competitive evaluation of all costs by the enhanced PD model
- Ramp down costs, if not recovered through market revenues, currently are addressed through an out of market payment called the ramp down settlement payment (RDSA)
- In future, generators will receive their LMP during ramp down to come offline; below MLP, the RT make-whole payment will not apply because it is assessed only when a resource is dispatched uneconomically, and generators are not able to respond to economic dispatch below MLP

Ramp Down Cost Recovery Options

- In order to address additional costs during ramp down, the IESO is considering either 1) the current out of market payment method or 2) inclusion of ramp down costs in the generator's start-up cost offer

Considerations:

- An out of market payment is not competitively evaluated, whereas the start-up cost would be evaluated along with other costs
- Generators would need to estimate ramp down costs in their offer
- The inclusion of the ramp down cost in the start-up cost offer would impact the MPM reference price; there is a methodology in place that was developed with generators to address ramp down cost recovery, and this could be applied to the reference price

Stakeholder feedback is requested.

DESIGN ELEMENT NO. 13: FAILURE CHARGE

Recap – Preliminary Decision - Failure Charge

- Failure charge is applied if a NQS generator fails to meet its PD commitment in RT
- Failure charges seek to ensure reliability, efficiency and reduce uplifts by incentivizing generators to uphold their PD commitment
- A failure charge will be applied when:
  - generator does not give adequate notice of its inability to meet its commitment;
  - the reasons the generator did not meet its commitment are unacceptable; and/or
  - there are financial implications of the failure to meet the commitment

Stakeholder Feedback & IESO Response

Feedback:

- The IESO has said that insufficient fuel is not an acceptable reason for failing to meet a commitment because this is in the control of the generator
- Exemptions/flexibility may be required due to inadequate lead time after binding start-up instruction for procurement and delivery of fuel to the facility

Response:

- The generator should include the time for delivery of fuel to its facility in its lead time offer curve

Stakeholder Feedback

Feedback:

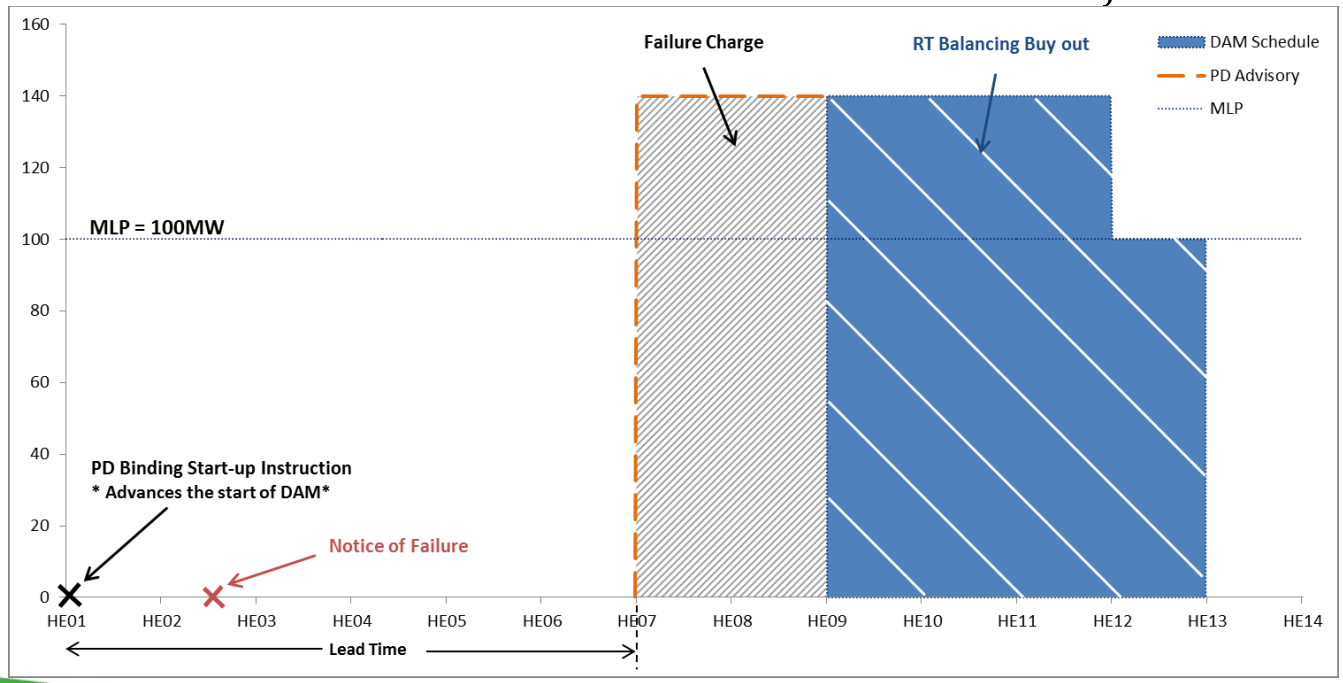
- Generators will have a binding financial schedule associated with the DAM; should that generator incur a forced outage in RT, not only will it be exposed to price differences between DAM and RT, but it will also be exposed to failure charges for not meeting its commitment in the real-time market

Response:

- The failure charge applies only to resources with operational constraints /commitments determined in the PD timeframe, not to the DAM financially binding schedule
- Participants with a DAM schedule have the incentive to participate in the RT market through the two settlement mechanism, so a failure charge is not required

Example

- Where the PD model advances or extends a DAM schedule, failure charge will only be assessed outside of the DAM schedule
- In the example below:
  - Failure charge will be assessed for HE 8 and HE 9 only
  - DAM schedule for HE 10 to HE 13 will be subject to RT buy out



WRAP UP & NEXT STEPS

Wrap up & Next Steps

- Requesting feedback on new preliminary decisions by August 17

- What's coming up?
  1. Discuss stakeholder feedback and IESO responses
  2. Identify any outstanding items

Summary of New Preliminary Decisions

Secondary Preliminary Decisions:

- Offer Changes: Offer price increases will be fully restricted and automatically prevented up to the advisory schedule quantity provided at the time the resource was initially committed; above this advisory schedule quantity, increases will be allowed only when the IESO identifies conditions that are resulting in intra-day volatility

- Timing and Frequency: In the event of a significant change in system conditions between DAM publishing and the first PD run that extends to the next day, the IESO may evaluate whether additional operational commitments are needed; operational commitments will be issued, if required, subject to a resource's submitted lead time

Acronyms

DAM	Day-Ahead Market
ERUC	Enhanced Real-time Unit Commitment
LAP	Look-Ahead Period
MGBRT	Minimum Generation Block Run-Time
MGBDT	Minimum Generation Block Down-Time
MLP	Minimum Loading Point
NQS	Non-Quick Start
OR	Operating Reserves
PD	Pre-Dispatch
RT-GCG	Real-Time Generation Cost Guarantee