

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

Stakeholder Meeting March 29, 2017

DISCLAIMER

This presentation and the information contained herein is provided for information and discussion purposes only. This presentation does not constitute, nor should it be construed to constitute, legal advice or a guarantee, representation or warranty on behalf of the IESO. In the event of any conflict or inconsistency between the information contained in this presentation and the Market Rules, the Market Manuals, any IESO contract or any applicable legislation or regulation, the provisions of the Market Rules, Market Manuals, contract, legislation or regulation, as applicable, govern.

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 option or lack of viable alternative option, where there is substantial consensus by the IESO and stakeholders as to a preferred option, or where internal analysis has led the IESO to propose a specific solution.
- Stakeholders are requested to use meeting time to discuss any comments, questions or concerns related to 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

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

Agenda

- Today's Objectives and Expectations
- Design Elements – Preliminary Decisions
- Next Steps

Today's Objectives and Expectations

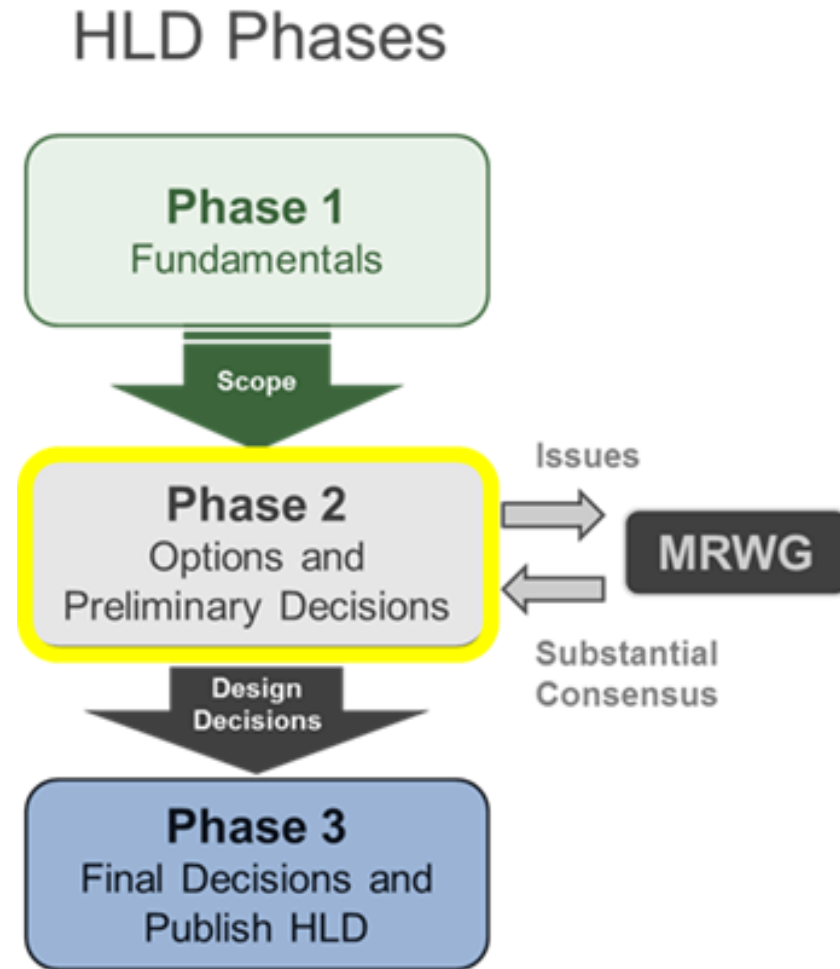
- The IESO will be presenting a set of preliminary decisions:
 - Look-Ahead Period
 - Timing and Frequency
 - Intertie Transactions
 - MP Data
 - Offer Changes
 - Make-Whole Payment
 - Failure Charge
- Stakeholders are requested to use meeting time to discuss any comments, questions or concerns related to these preliminary decisions and are also invited to provide written feedback by April 27, 2018

Recap – ERUC Project Purpose

- Design a security constrained unit commitment, jointly optimizing energy and operating reserves over the look-ahead period, in the pre-dispatch timeframe
 - Replace the current RT-GCG program
 - Minimize overall production costs
- Consider all resource offers to determine optimal mix of resources to meet system requirements
- Commit eligible resources that are lowest cost to meet system requirements

High Level Design

We are now in Phase 2 of the HLD for the ERUC Project.



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	Today	N/A
		3	Timing and Frequency of Run	Today	May meeting
		4	Time Step	Complete	N/A
B	Participation and Input Data	5	Intertie Transactions	Today	May meeting
		6	Must Offer Requirements	Mar 28	May meeting
		7	Eligibility for Make-whole	Complete	N/A
		8	Market Participant Data	Complete	Today
C	Market Power Mitigation	9	Commitment Cost Mitigation	Update Mar 28	May meeting
		10	Offer Changes	Today - clarification	Today
D	Output of Engine	11	Binding Start-up Instruction and Operational Constraint	Complete	May meeting
E	Settlements	12	Calculation of Make-whole Payment	Today	May meeting
		13	Failure Charge	Complete	Today

DESIGN ELEMENT NO. 2: LOOK-AHEAD PERIOD

Recap – Look-Ahead Period (LAP)

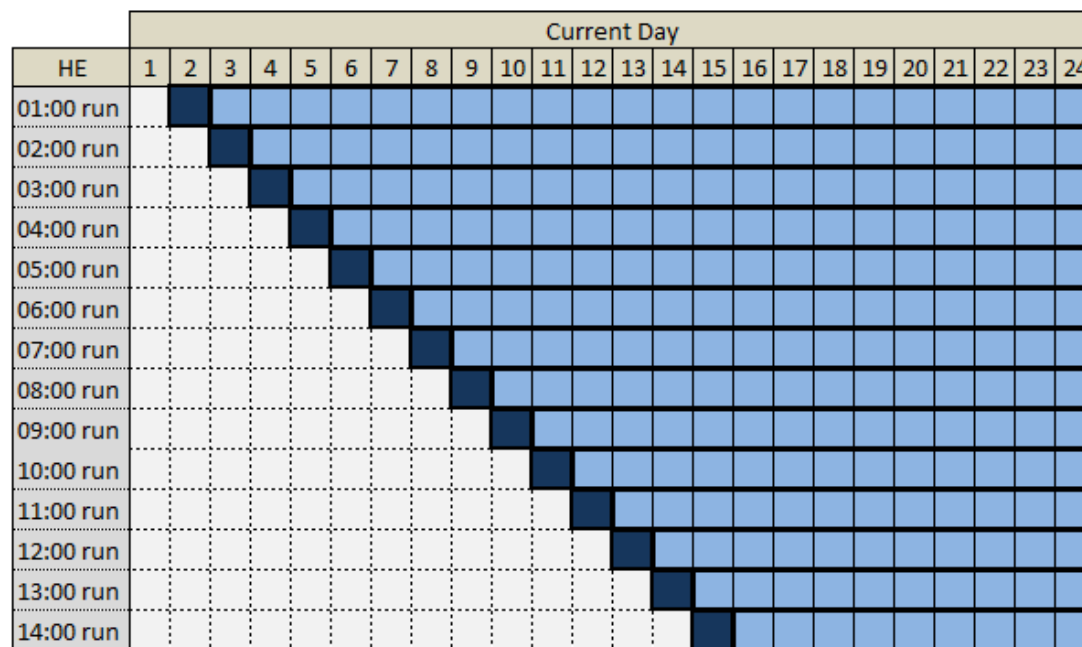
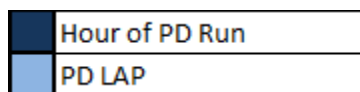
- Establishes the timeframe over which the optimization is performed

Requirements:

- Consider the majority of NQS units given their start-up and minimum run times
- Consider multiple peaks across the day in the same optimization
- Consider utilization of resources with operating limitations over the full day

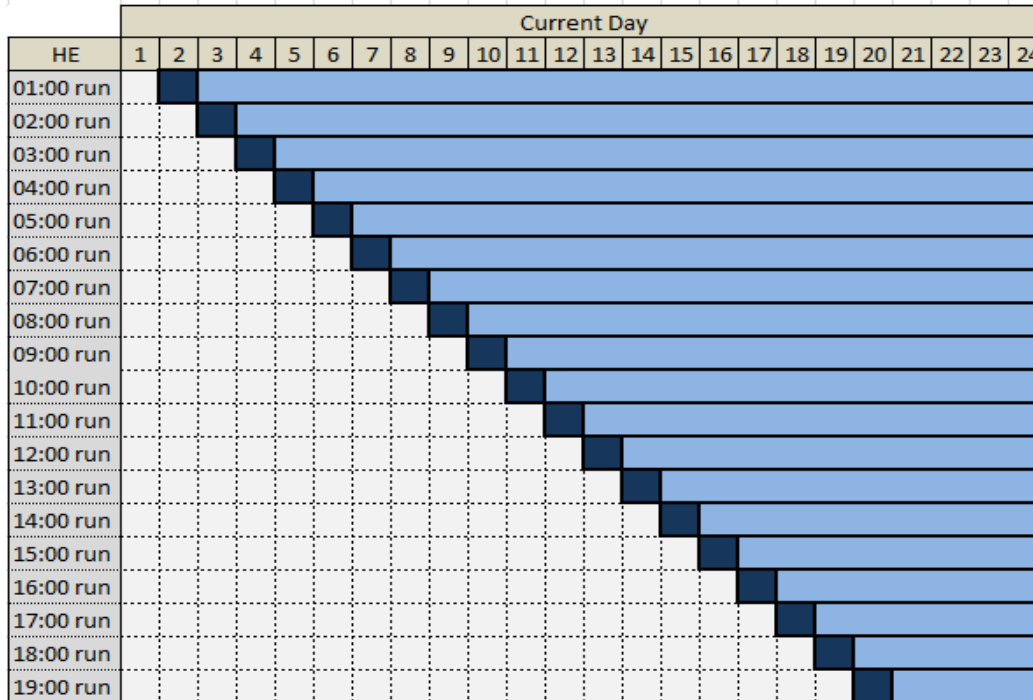
Current: Pre-Dispatch LAP prior to 15:00

- Although the evaluation period extends to end of day, each hour is optimized independently i.e. LAP is one hour
- Operational constraints from DACP are respected
- Prior to 15:00, every PD run evaluates single part offers for each remaining hour of the current day, without considering resource operating restrictions

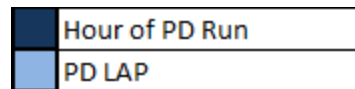


Future - LAP prior to 20:00

- Multi-hour optimization is performed over the entire evaluation period i.e. LAP is multiple hours

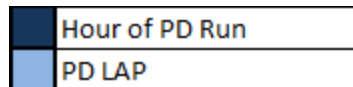
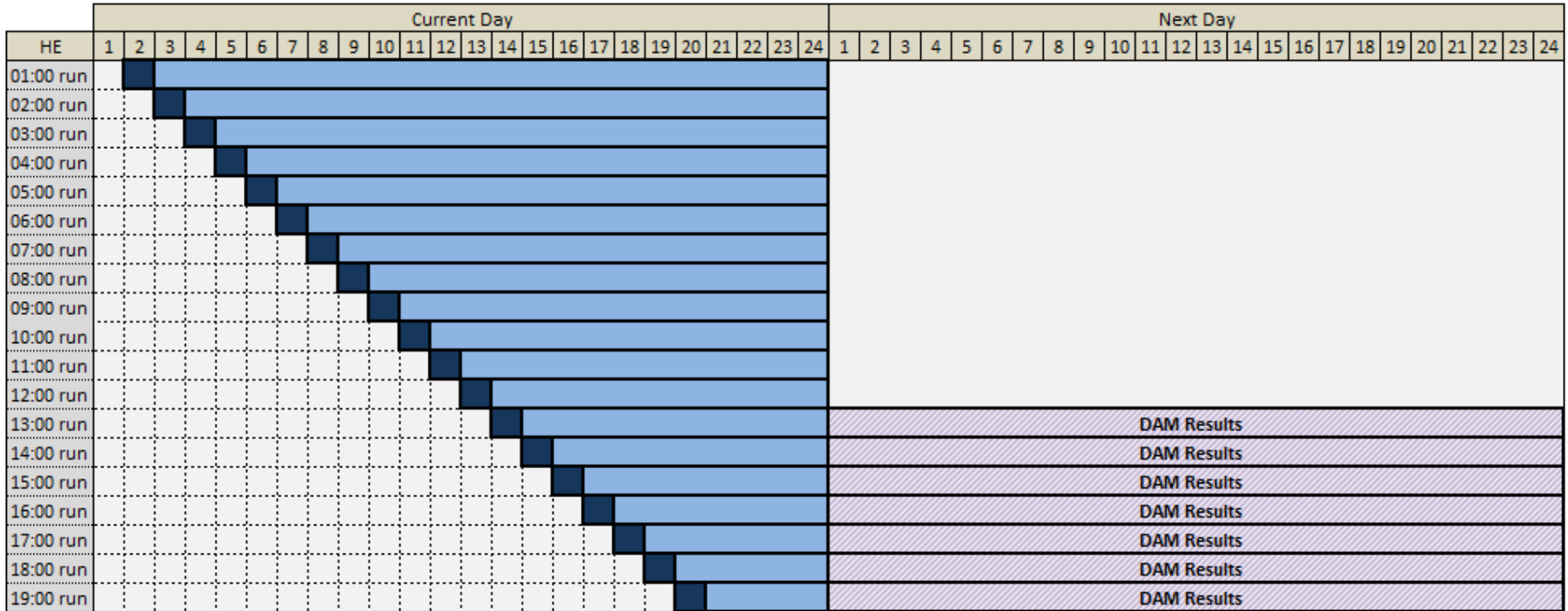


- Prior to 20:00, every PD run evaluates all offers, including three-part offers, for the remaining hours of the current day while considering resource operating restrictions

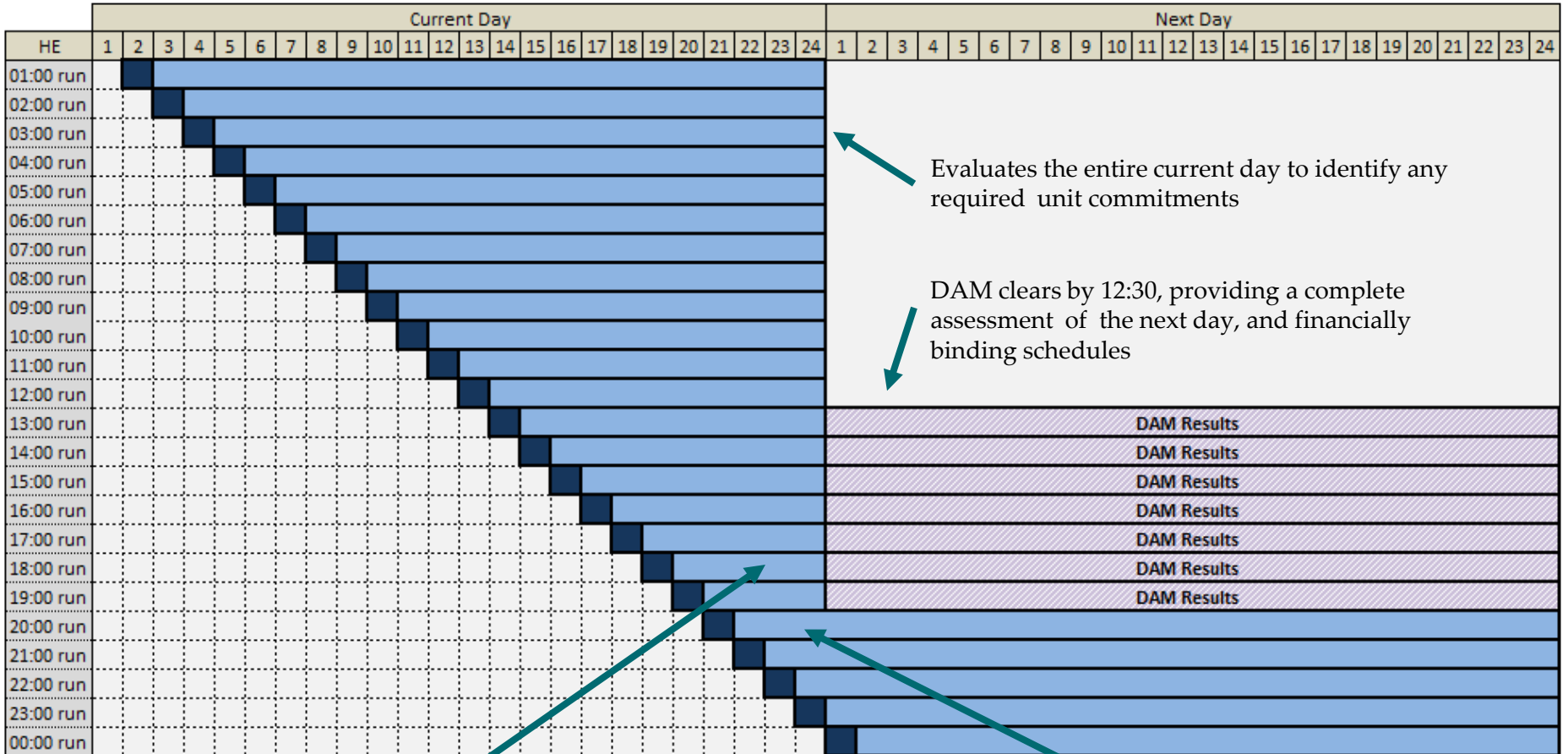


Future - LAP prior to 20:00 Cont'd.

- DAM clears by 12:30 pm, providing financially binding schedules



Preliminary Decision



Evaluates the entire current day to identify any required unit commitments

DAM clears by 12:30, providing a complete assessment of the next day, and financially binding schedules

DAM Results

DAM Results

DAM Results

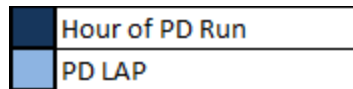
DAM Results

DAM Results

DAM Results

DAM Results

Shorter LAP later in the day



LAP starts bridging with the next day

Preliminary Decision & Rationale

- The LAP will start at hour T+1 and will include hours for the rest of the operating day, extended to include hours of next day:
 - The first run that includes all hours of the next day will be the 20:00 run with a LAP from HE22 current day to HE24 next day, resulting in a 27 hour LAP
 - Each run will be reduced by one hour as we move through the day. The shortest LAP will be the 19:00 run with a 4 hour LAP for HE21-HE24
- **Rationale:** consideration of most NQS units; scheduling of ELRs while respecting daily energy limits; early assessment of both peaks in one optimization; convergence between current day and DAM commitments and to ensure resources are available at morning peak

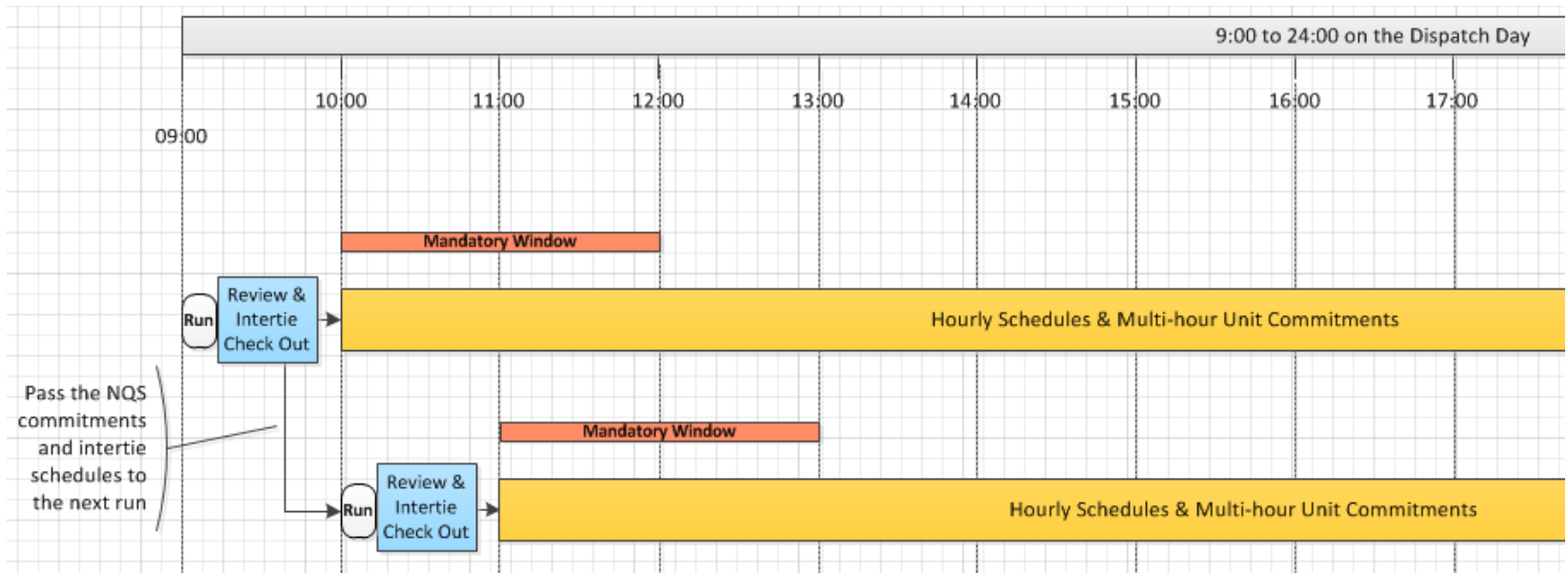
DESIGN ELEMENT NO. 3: TIMING AND FREQUENCY OF RUNS

Recap – Timing and Frequency

- Establishes when & how often the PD engine will run
- The timing and frequency will affect:
 - the efficiency with which the economic evaluation commits resources
 - the amount of notice provided to generators that are required to meet system needs
- Need to consider:
 - the amount of time and operator attention necessary to complete the run
 - incorporation of up-to-date near term interchange schedules

Preliminary Decisions: Timing & Frequency

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



For illustrative purposes only

Preliminary Decision & Rationale - Timing

- For forecast hours T+1 and T+2, schedules will be published no later than 15 minutes past the hour
- Rationale: This timing facilitates check out process for interchange scheduling, which must be completed by 40 minutes past the hour, as well as PD-2 checkout processes e.g. NY-90
- For all hours, schedules will be published no later than 30 minutes past the hour
- Rationale: This timing allows participants to review their advisory schedules and commitments, and make offer changes before the mandatory window

Preliminary Decision & Rationale - Frequency

- The pre-dispatch evaluation will run hourly

Rationale:

- Efficiency – able to commit the lowest cost resource in a timely manner
- Improved reliability if system conditions change
- Hourly run is consistent with current pre-dispatch, including interchange scheduling, and provides informational benefits (advisory prices and schedules updated hourly) for IESO and MPs

Secondary Design Considerations

- How would failure of the DAM to clear be addressed in the pre-dispatch timeframe?
- What actions may be taken in the case of significant changes in system conditions during the timeframe between publishing of DAM results at 12:30 and the first run extending into next day at 20:00?

DESIGN ELEMENT NO. 5: INTERTIE TRANSACTIONS

Recap – Intertie Transactions

- Addresses whether the pre-dispatch 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

Considerations

- Intertie offers and bids evaluated by pre-dispatch should be expected to be available in RT
 - System reliability can be compromised if commitment decisions are premised on import offers that may not be available to be scheduled in RT
 - Committing units to support export bids that are withdrawn or reduced prior to RT can increase costs to consumers

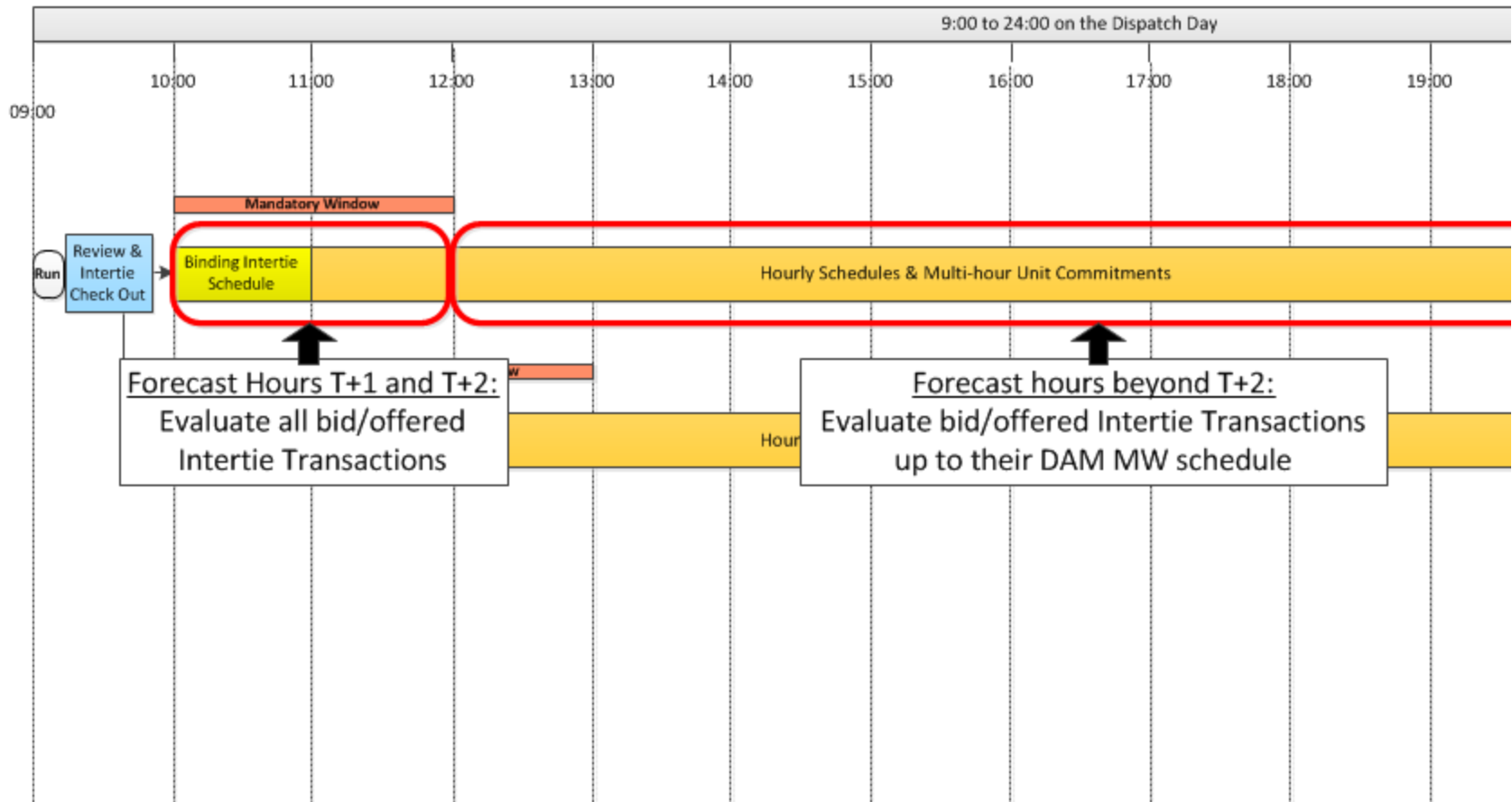
Recap - Options

1. Evaluate intertie offers and bids for transactions up to their DAM scheduled quantity, except in T+1 where all intertie offers/bids i.e. DAM scheduled and non-DAM scheduled will be evaluated for interchange scheduling
2. For all LAP hours, evaluate all intertie offers/bids i.e. DAM scheduled and non-DAM scheduled; for intertie offers/bids over their DAM scheduled quantity:
 - prices and quantities would be fixed once they receive an advisory schedule
 - penalties would be applied to any portion of those fixed schedules that does not flow in RT for reasons other than ISO actions

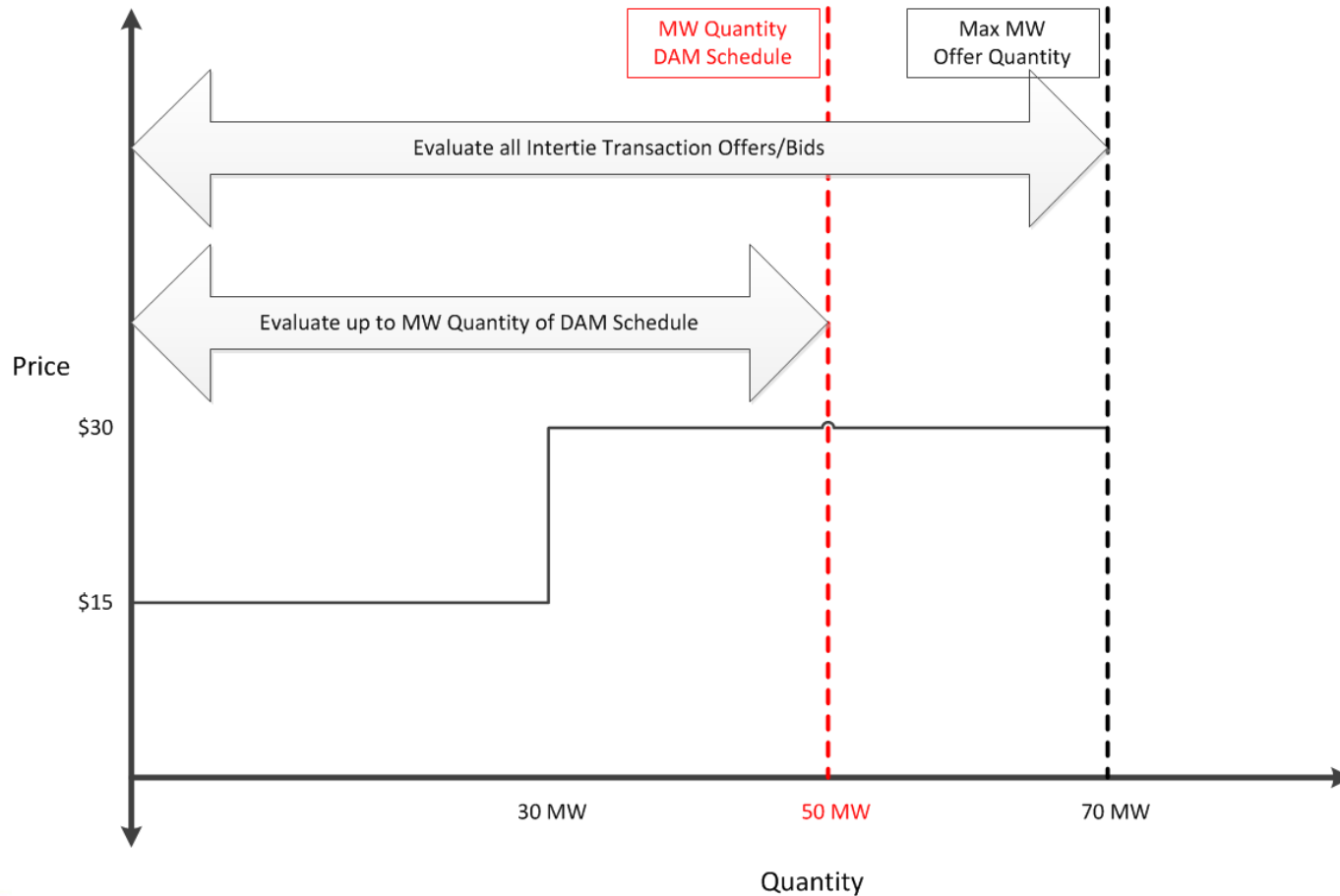
New Option 3

- For T+1 and T+2, evaluate all intertie offers/bids i.e. DAM scheduled and non-DAM scheduled
- For rest of LAP, evaluate intertie offers/bids up to their DAM scheduled quantity only

Option 3 – Timeline Illustration



Evaluating All Intertie Transactions vs. Up to MW quantity of DAM Schedule



Preliminary Decision & Rationale:

- **Option 3**

It is appropriate to evaluate all intertie bids/offers including non-DAM scheduled in both T+1 and T+2:

- Increased certainty that non-DAM scheduled transactions will flow in real-time because of:
 - Alignment with intertie scheduling timelines in other markets
 - Alignment with existing mandatory window
- Allows non-DAM scheduled intertie transactions to participate in the real-time market

Preliminary Decision & Rationale:

- **Option 3**

It is appropriate to evaluate only DAM-scheduled inertie bids/offers T+3 and beyond:

- Unit commitment decisions made at T+3 or further in advance of real-time should:
 - primarily be used to satisfy Ontario demand and reserve requirements
 - not be adversely influenced by non-DAM scheduled inertie transactions that have less certainty of flowing in real-time
- Reinforces inertie transaction participation in two distinct timeframes: DA Market and RT Energy Market

Secondary Design Decisions

Consider exceptions to the rule for:

- Capacity-backed imports and exports
- Emergency/shortage situations in Ontario or other jurisdictions
- Should an intertie bid/offer that does not have a DAM schedule but is associated with a capacity call or an emergency purchase/sale be evaluated in all PD LAP hours (not just T+1 and T+2)?

DESIGN ELEMENT NO. 8: MARKET PARTICIPANT DATA

Recap – Market Participant Data

- Establishes the data necessary to economically evaluate unit commitment of resources eligible for make-whole payments
- Pre-dispatch will consider three-part offers (energy, speed-no-load and start-up costs) 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)

Recap - Primary Preliminary Decision

- NQS Generators 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 offered data i.e. non-price offer parameters
- Will operational data be provided as registered data only, or also as non-price offer parameter data?

Secondary Preliminary Decision 1 & Rationale

- NQS resource registration data submissions will be the same as current requirements with the addition of new registered data for lead time
- Rationale: This data is needed as standing data in the absence of offered data, and may be used for market power mitigation reference level setting

Secondary Preliminary Decision 2 & Rationale

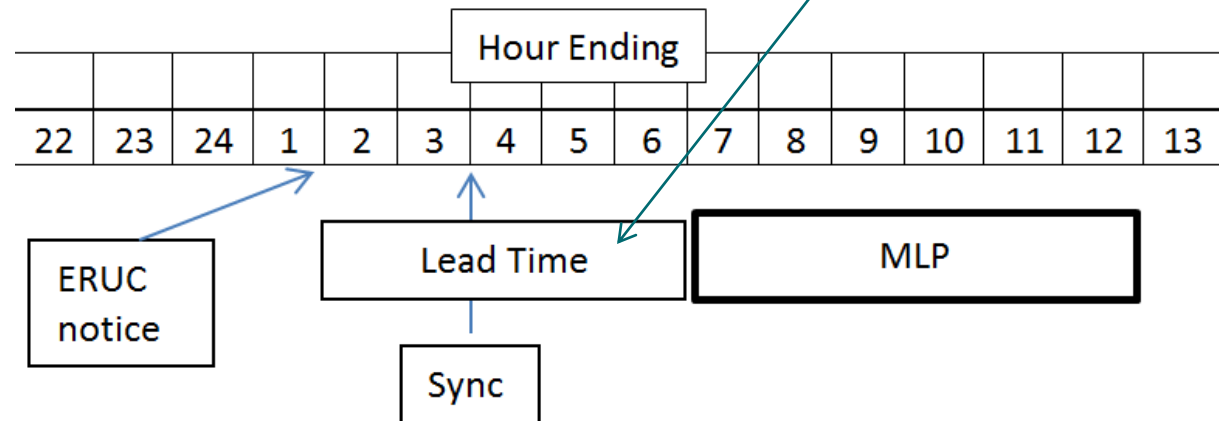
- NQS resource non-price offer parameter data will be the same as the current DACP daily generator data (DGD), with opportunity to offer lead time DGD also
- Rationale: Operating parameters are not static; generators need to be allowed to make changes to reflect expected physical capability on a more regular basis than can be managed through the market registration process

Lead Time Example

- At 9 am, generator submits updated DGD for its lead time curve
- Generator meets its DAM commitment starting at noon, and operates until 9 pm
- At start of next day, PD knows that the resource will have been offline for 4 hours if committed by the current run of PD
- PD run completed at 00:30 correctly commits the unit based on reaching MLP in HE7 because this is the first hour it is capable of doing so with a 5 hour lead time (HE2-6)

Lead Time Curve

# Hours Offline	Lead Time
< 4	3
4 to 10	5
> 10	10



Stakeholder Feedback and IESO Response

Feedback:

- Lead time should be provided as hourly offered data to capture the most accurate information
- An additional parameter is required to identify the duration required following reaching MLP, before normal (hot) ramp rates are available

IESO Response:

- Pre-dispatch will have information indicating how many hours a resource has been offline, and will utilize the lead time curve data provided by the generator on a daily basis to commit
- Lead time for each operating state (cold, warm, hot) should not change significantly during the day, and could include hold time

DESIGN ELEMENT NO. 10: OFFER CHANGES

Recap – Offer Changes

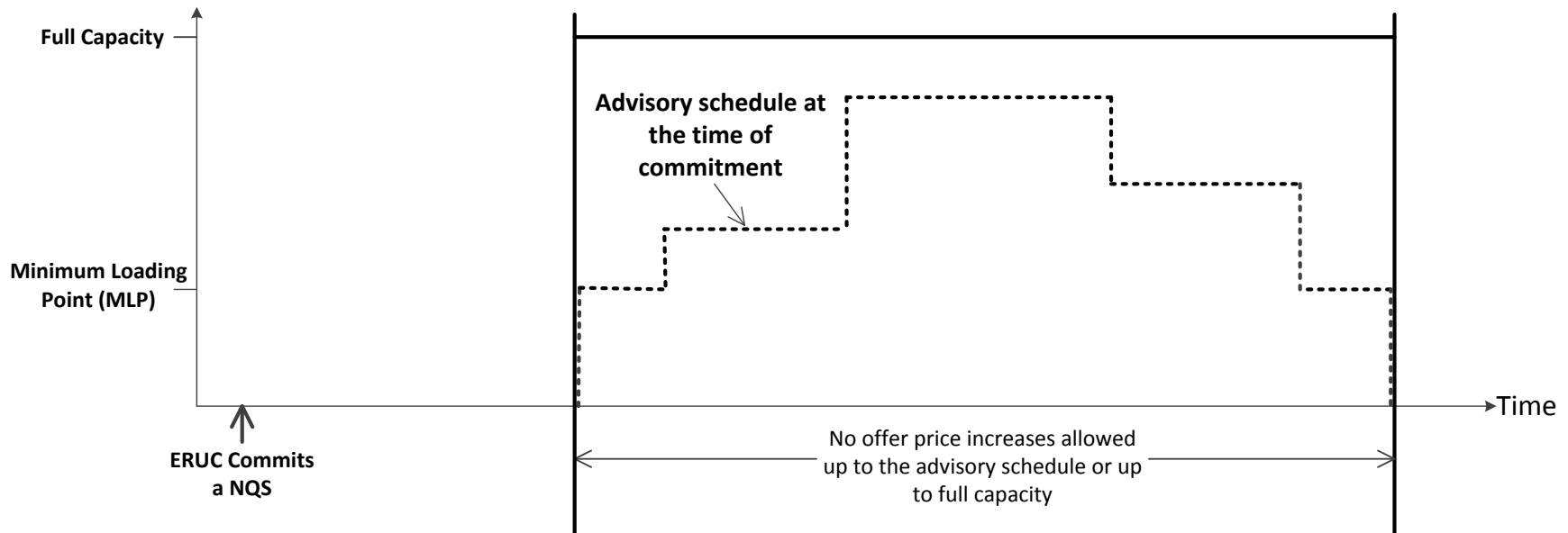
- During the period after the DAM clears until real-time dispatch, restrictions apply for:
 - increases in commitment cost offers, incremental energy offers and OR offers
 - changes that make non-price offer parameters more limiting
- Restrictions must be applied to offer changes when a generator has a DAM schedule or a PD commitment in order to limit increases in uplift costs and improve efficiency of commitments

Recap – Primary Preliminary Decision 1

- No offer price increases allowed for the hours that a resource is committed by pre-dispatch
- Rationale: Addresses potential uplift impacts, exercise of market power, and inefficient resource commitment
- Clarification: “No offer price increases allowed for the hours that a resource is committed” means 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

New - Secondary Design Consideration

- Need to establish the quantity for the restriction
- 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 capacity of the resource



For illustrative purposes only

Stakeholder Feedback and IESO Response

Feedback:

- Offer price increases should not be restricted for quantities that were not committed

IESO Response:

- The decision to commit is based on evaluation of the entire advisory schedule provided at the time of commitment
- Once committed, generators that are marginal will often be the low cost resource up to full capacity compared to a new NQS resource commitment, providing information that allows it to influence price

FOR DISCUSSION

Review of Primary Preliminary Decision 2

- No changes that make non-price offer parameters more restrictive will be allowed for a resource after its commitment in pre-dispatch
- Rationale: Changes that are made after commitment can undermine reliability and increase uplifts
 - Changes that make non-price offer parameters more restrictive can increase cost of the commitment, and could also adversely impact reliability if the unit cannot provide energy in RT

Stakeholder Feedback and IESO Response

Feedback:

- Revisions in non-price offer parameters should be allowed in order to reflect actual unit capabilities

IESO Response:

- Changes are allowed until a resource is committed
- After commitment, changes that make non-price offer parameters more restrictive can increase the cost of commitment, and may impact reliability
- If the resource has changes in its ability to operate as committed, it should inform the IESO as soon as possible, and it will be subject to the failure charge, if applicable

Review of Primary Preliminary Decision 3

- No commitment cost increases and no changes that make non-price offer parameters more restrictive will be allowed for the hours a resource has a DAM schedule
- Rationale: Changes that are made after commitment can undermine reliability and increase uplifts
 - Changes that make non-price offer parameters more restrictive can increase cost of the commitment, and could also adversely impact reliability if the unit cannot provide energy in RT

Recap - Secondary Design Considerations

- To enforce offer change restrictions:
 - should attempts to change offers inappropriately be automatically prevented;
 - should contraventions of the offer change restrictions be dealt with through settlement calculations; and/or
 - should contraventions of the offer change restrictions be dealt with under a compliance regime?

Secondary Preliminary Decision & Rationale

- Enforcement of offer change restrictions will be automated to the extent possible, as further determined in detailed design
- Attempts to change offers in contravention of market rules will be automatically prevented in our systems
- Rationale: Automation will reduce the need for after the fact settlement adjustments and compliance actions

DE10 Offer Changes - Next Steps

- Provide feedback on how to address potential issues if the quantity for the offer price restriction after pre-dispatch commitment is limited to the advisory schedule versus the full capacity of the resource
- Any further feedback or questions on other preliminary decisions (primary or secondary) may be provided

DESIGN ELEMENT NO. 12: CALCULATION OF MAKE- WHOLE PAYMENT

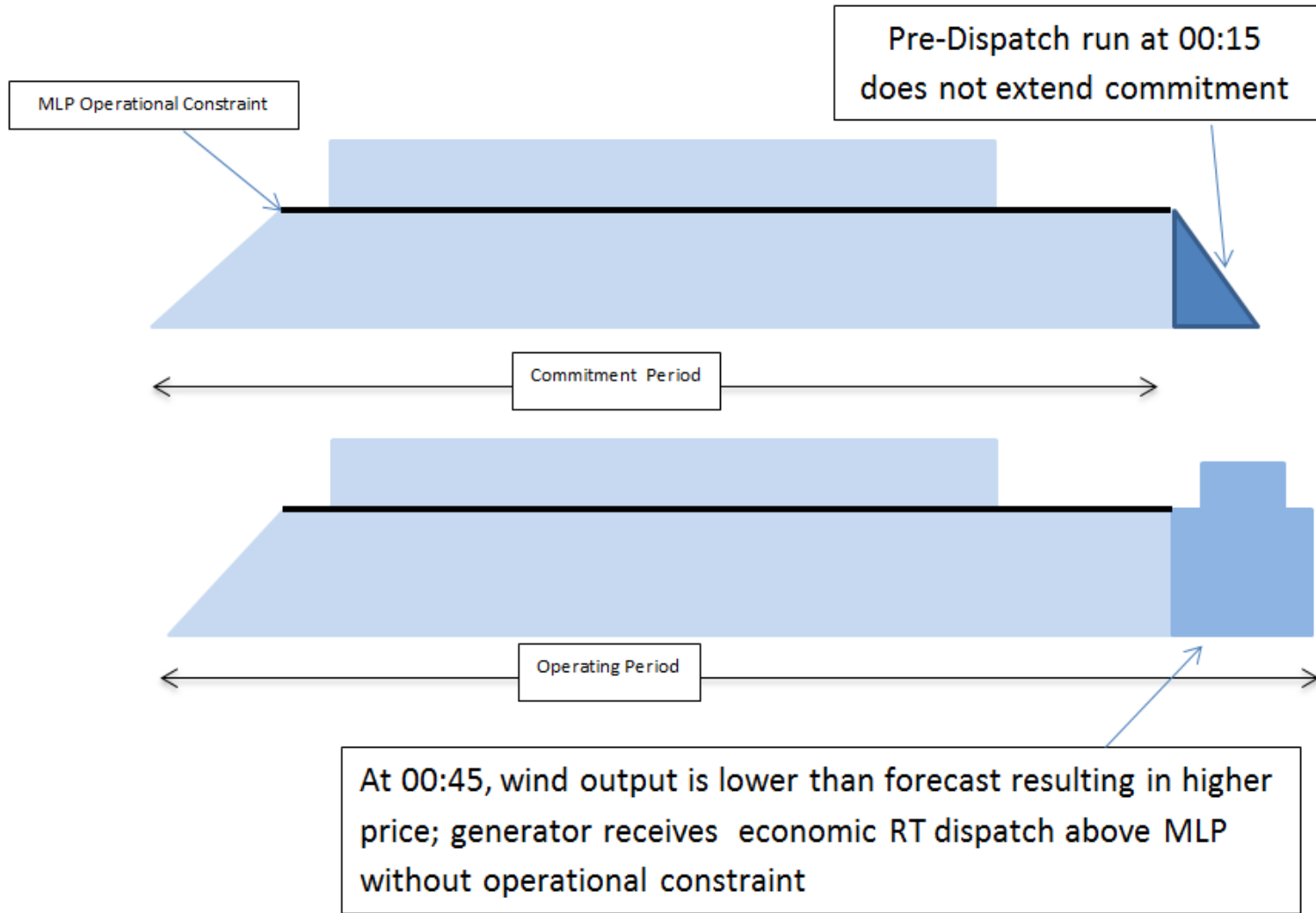
Recap – Calculation of Make-whole Payment

- Calculation should include all energy and OR revenues, net of all as-offered costs: commitment costs, incremental energy costs and OR costs
- Make-whole payment is intended to provide the incentive for the lowest cost generator to operate when needed to meet system requirements
- If generator revenue is greater than its costs, it will keep the profits and no make-whole payment will be required

Recap – Calculation of Make-whole Payment

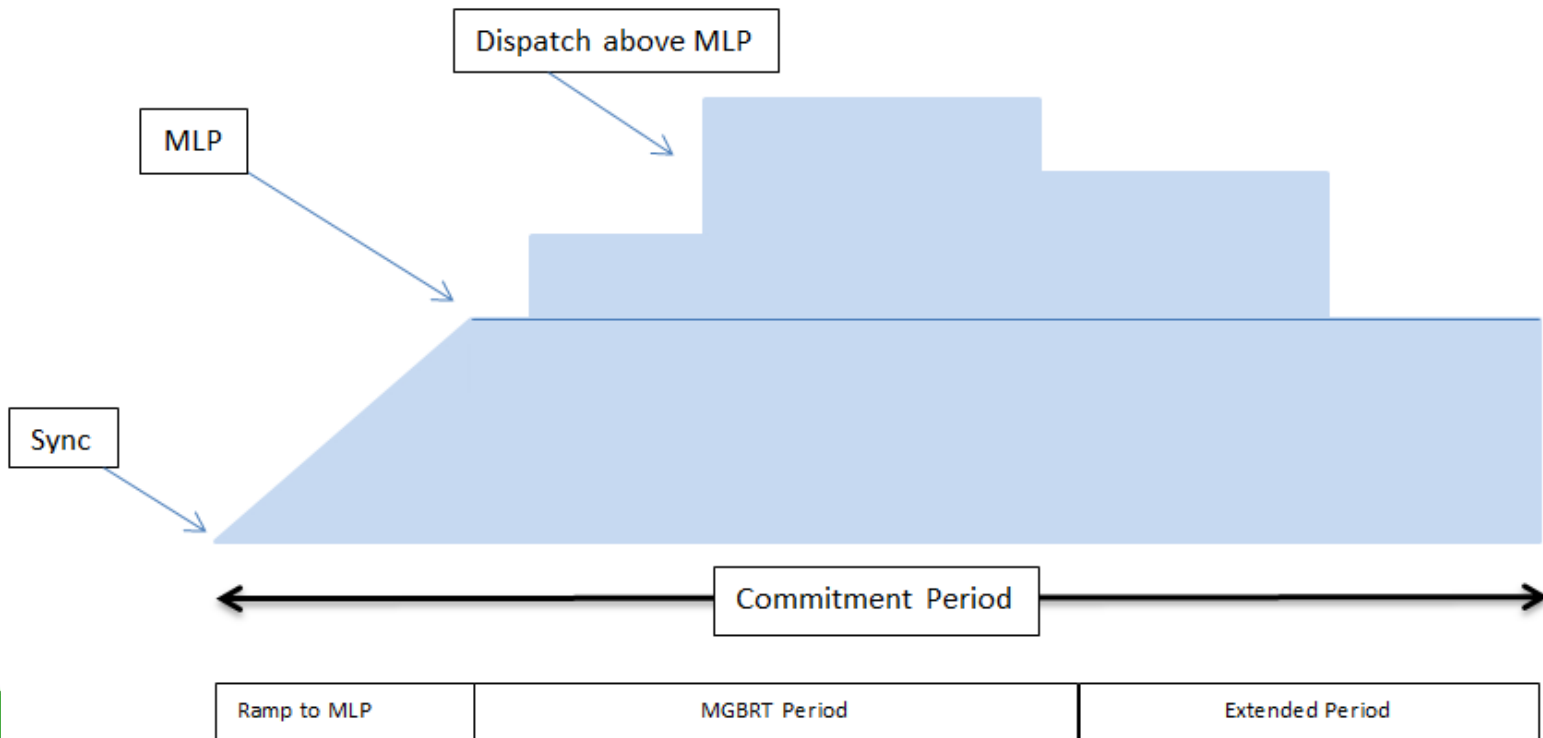
- Need to decide if make-whole payment should be calculated over the commitment period (option 1) or the operating period (option 2)
- Commitment period is the entire period of time that the generator is constrained at MLP, which may or may not extend beyond MGBRT
- Operating period includes the commitment period as well as the timeframe after PD indicates that the resource is no longer required and MLP constraint has been removed, allowing ramp down

Commitment versus Operating Period



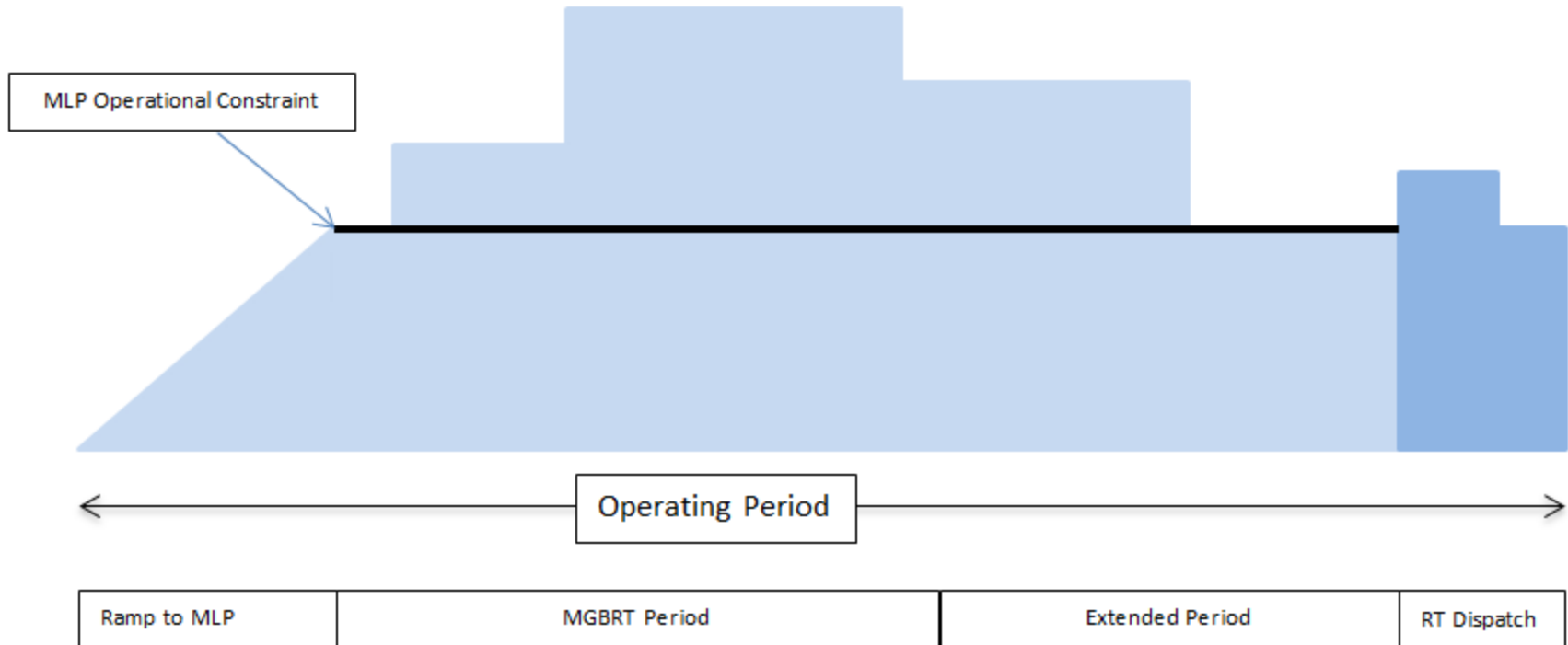
Recap - Option 1

- Make-whole payment includes all energy and OR revenues, net of all as-offered commitment costs, incremental energy costs and OR costs over the commitment period



Recap - Option 2

- Make-whole payment includes all energy and OR revenues, net of all as-offered commitment costs, incremental energy costs and OR costs over the operating period of the resource



Primary Preliminary Decision

- Option 1: All costs and revenues that were evaluated and optimized over the commitment period will be included in make-whole calculation
- Provides incentive/sufficient revenue for generators to come online and operate when they are the lowest cost resource that can meet system requirements
- Provides incentive/profit opportunity for generators to respond to RT changes
 - the last run of pre-dispatch for the operating hour determines that the resource is not required
 - system conditions change and the generator is economically dispatched in RT

Secondary Design Considerations

- What will make a NQS generator ineligible for part or all of the make-whole payment?
- Will multiple commitment periods in one day be paid separately?
- Do reliability commitments get a separate make-whole?
- What is the impact on the calculation if the resource:
 - trips or does not follow dispatch?
 - lowers offers after commitment?
 - reaches MLP earlier or later than committed?
 - has a commitment that crosses over 2 days?
 - is online from previous day?

Energy Work Stream Decisions

We will also consider the following item as part of a joint discussion for the Energy work stream:

- What is the interaction between the DAM make-whole payment and the pre-dispatch make-whole payment?

DESIGN ELEMENT NO. 13: FAILURE CHARGE

Recap – Failure Charge

- A financial charge if a NQS generator fails to meet its pre-dispatch commitment in RT
- Failure charges seek to ensure reliability, efficiency and reduce uplifts by incentivizing generators to uphold their pre-dispatch commitment

Recap - Primary Preliminary Decision

- 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

Secondary Preliminary Decision 1 & Rationale

- What is adequate notice of inability to meet a commitment?

There is no minimum advance notice that is adequate to indicate inability to meet a pre-dispatch commitment and to avoid a failure charge; however, the calculation of the charge will depend on when notice was provided (slide 67)

- Rationale:
 - a commitment indicates the generator is the lowest cost resource to meet system needs; advance notice doesn't change this
 - if the NQS resource fails to fulfil its commitment, replacement generation must be dispatched, incurring system costs

Secondary Preliminary Decision 2 & Rationale

- What are acceptable reasons for failure to meet commitment?

A failure charge will not be applied if the resource is unable to meet a pre-dispatch commitment because it is grid incapable due to an outage on the electrical system.

- Rationale:
 - an outage on the electrical system is the fault of another party's equipment
- Unacceptable reasons for failing to meet a commitment include insufficient fuel to operate and tripping; these are not the fault of another party's equipment and are within the influence of the generator

Secondary Preliminary Decision 3 & Rationale

- What financial implications would trigger a failure charge upon failure to meet commitment?

Financial impact of failure will be assessed for the advisory schedule quantity based on the difference between the generator offer and their LMP (cap \$0), plus incremental uplift cost to replace the resource if applicable.

- If notice is provided at least 4 hours before the beginning of the commitment/operational constraint, the LMP used will be the lesser of the hour ahead pre-dispatch LMP and the RT LMP, otherwise the RT LMP will be used
- Rationale:
 - this approach is similar to the existing Day-Ahead Generator Withdrawal Charge; the intent is to capture reliability and price impacts, and recognize additional uplift costs

Stakeholder Feedback and IESO Response

Feedback:

- Legitimate circumstances where a facility may fail to meet a commitment include curtailment with short notice by a natural gas distributor, host LDC or transmitter forced outage or unit trips on start-up

IESO Response:

- It is not feasible to identify every circumstance that may cause failure to meet a commitment
- A failure charge will not be applied if a resource is grid incapable due to an outage on the electrical system; other reasons for failure may be addressed on an adhoc basis

NEXT STEPS

Wrap up and Next Steps

- Feedback on new preliminary decisions requested April 27 or earlier
- What's coming up in May – secondary preliminary decisions for:
 - Timing
 - Intertie Transactions
 - Offer Changes
 - Binding Start-up Instruction and Operational Constraint
 - Make-Whole Payment

Summary of New Preliminary Decisions

Primary Preliminary Decisions:

- **Look-Ahead Period:** Starts at hour T+1 and includes hours for the rest of the operating day, extended to include hours of next day; the first run that includes all hours of the next day will be at 20:00
- **Timing and Frequency:** T+1 & T+2 published by 15 min past hour; all hours published by 30 min past hour; Hourly run frequency
- **Intertie Transactions:** For T+1 and T+2, evaluate all intertie offers/bids i.e. DAM scheduled and non-DAM scheduled; for rest of LAP, evaluate intertie offers/bids up to DAM scheduled quantity
- **Offer Changes (Clarification):** No offer price increases allowed in the energy and operating reserve markets for the hours in the advisory schedule when the resource was initially committed
- **Make-Whole Payment:** All costs and revenues that were evaluated and optimized over the commitment period will be included in make-whole calculation

Summary of New Preliminary Decisions

Secondary Preliminary Decisions

- **MP Data:**
 - NQS resource registration data submissions will be the same as current requirements with the addition of new registered data for lead time
 - NQS resource non-price offer parameter data will be the same as the current DACP daily generator data with opportunity to offer lead time DGD as well
- **Offer Changes:**
 - Enforcement of offer change restrictions will be automated to the extent possible; attempts to change offers in contravention of market rules will be prevented
- **Failure Charge:**
 - No minimum advance notice is adequate to avoid a failure charge; however, the calculation of the charge will depend on when notice was provided
 - Failure charge will not be applied if the resource is unable to meet a pre-dispatch commitment because it is grid incapable due to outage on the electrical system
 - Charge for advisory schedule based on difference between generator offer and their LMP, plus incremental uplift cost to replace the resource if applicable