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

September 20, 2018

ieso
Connecting Today.
Powering Tomorrow.

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.

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

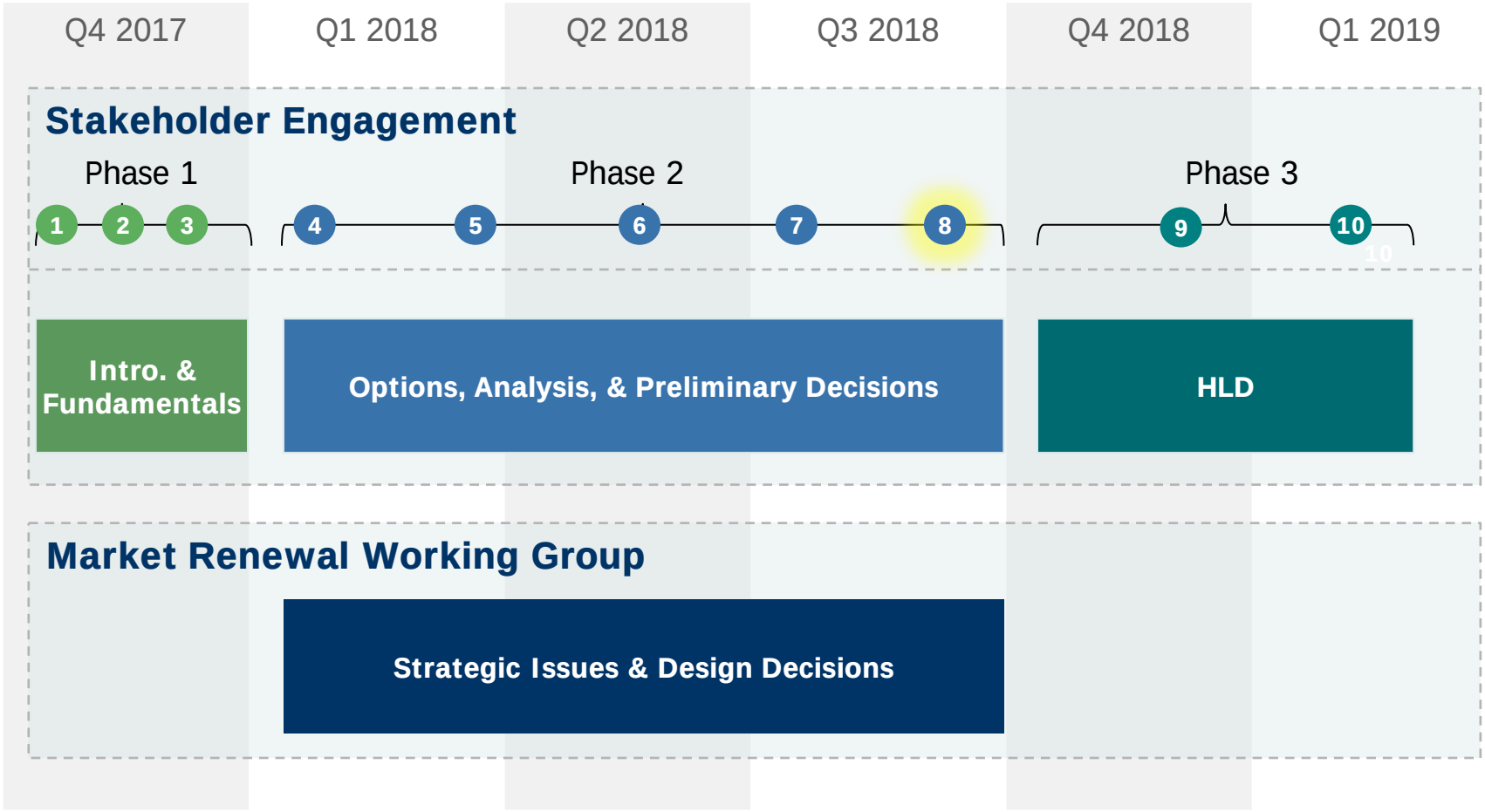
*Resources eligible for an operational constraint are generators that take a long time to start-up, and must stay online for a min. number of hours at a min. injection level for equipment reasons.

Today's Agenda

Stakeholder Feedback & IESO Responses related to:

- Future Pre-Dispatch Process
- Design Element #2 – Look Ahead Period
- Design Element #3 – Timing & Frequency
- Design Element #5 – Intertie Transactions

ERUC Project Timeline for High Level Design



ieso
Connecting Today.
Powering Tomorrow.

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	Complete
		4	Time Step	Complete	N/A
B	Participation & Input Data	5	Intertie Transactions	Complete	Complete
		6	Offer Obligations/Reference Quantity	Complete	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	Complete
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

OVERVIEW:
FUTURE PD PROCESS

Stakeholder Feedback – Future PD Process

Stakeholder Feedback:

- The interaction between look-ahead period, advisory schedule, binding start-up instruction / operational constraint, and physical operation of the generator remains cloudy

IESO Response:

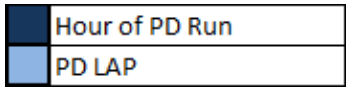
- The following 4 slides explain interactions between various design elements and the resulting physical RT operations

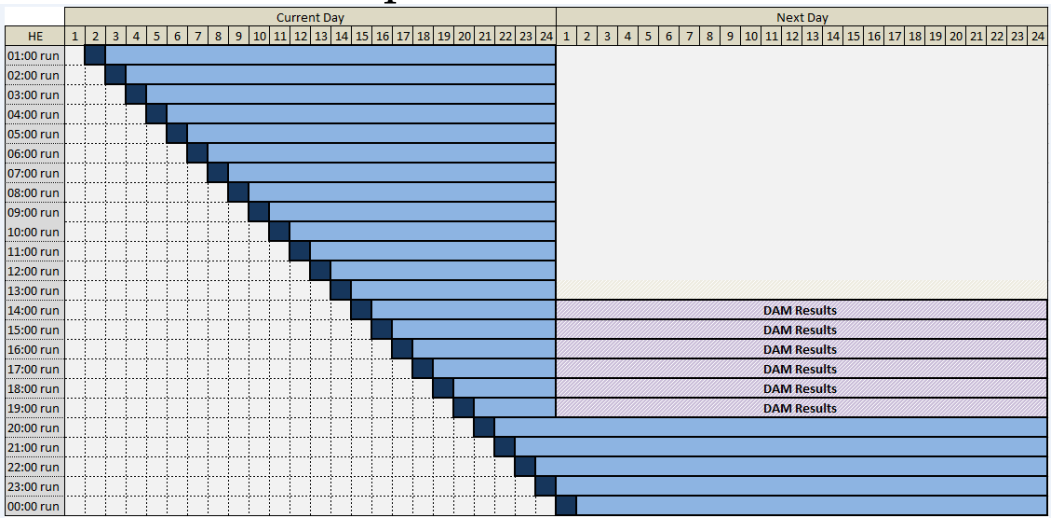
PD Process Overview (1) – Optimization

1. Dispatchable resources (including loads, exports, imports & generators - CCP/non-CCP) will submit the applicable hourly dispatch data such as energy offers, start-up offer, speed-no-load offer and ramp rate offers, as well as daily generator data such as lead time curve, MLP, MGBRT
2. Every hour, the pre-dispatch model will evaluate all data for <u>all</u> resources over the look-ahead period
3. By 30 minutes past the hour, PD will provide advisory schedules for all resources for each hour of the look-ahead period

Right:

PD optimization run times and corresponding look ahead periods





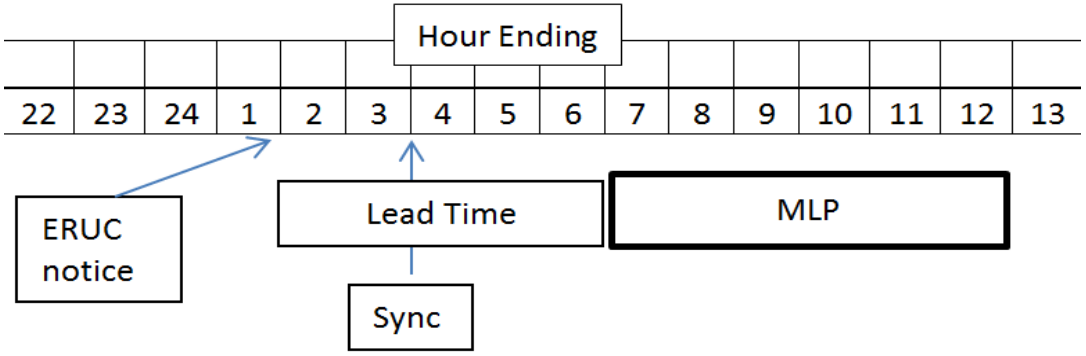
ieso
Connecting Today.
Powering Tomorrow.

PD Process Overview (2) – PD Schedules

- For all resources, PD advisory schedules will be provided every hour, indicating quantity for which each resource is expected to be economic in RT
- Specifically for NQS resources including CCP, PD schedules will:
  - Indicate when the resource is economic at or above MLP
  - Include assumptions for sync and ramp to MLP
  - Be advisory until PD determines that the resource must be committed (with a binding start-up instruction & operational constraint), based on the lead time notice the resource tells us they require to get to MLP

Right:

Example - Timing for future PD notices to NQS generators



PD Process Overview (3) – 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 how long they are offline
- Generator will submit lead time curve data for its resource (CCP, if applicable)
- This info will be used by the PD evaluation, along with IESO knowledge of how long the physical units have been offline, to determine if and when to provide a binding start-up instruction and operational constraint

Sample Lead Time Curve

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

For example:

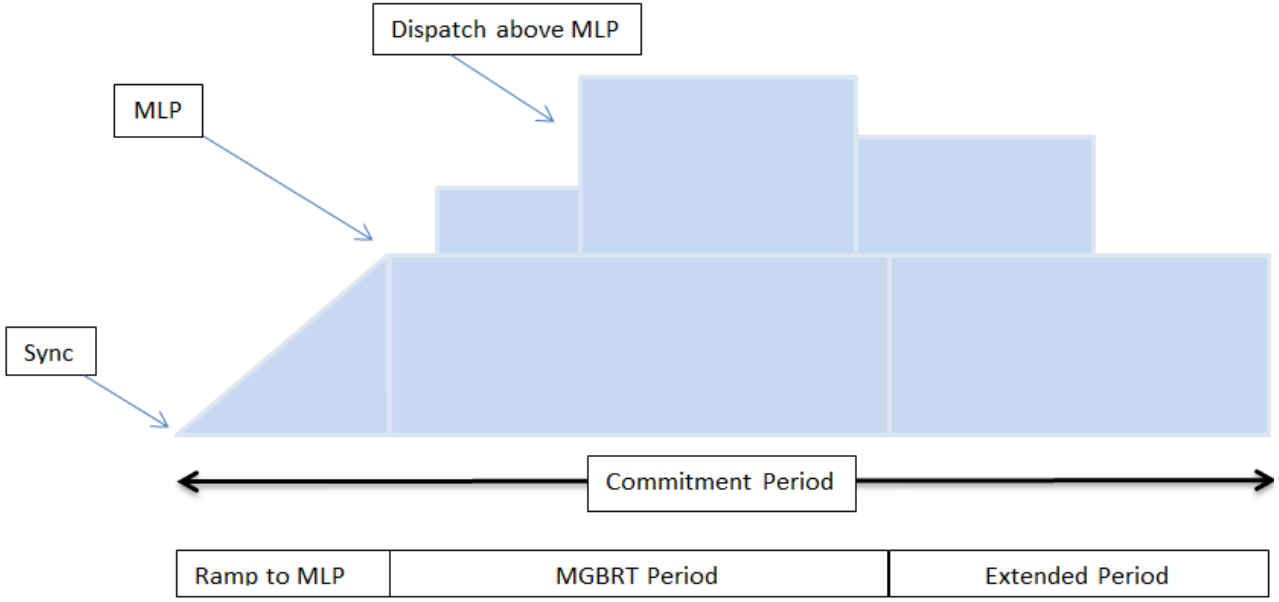
- Generator has told the IESO that when their CCP has been offline/not injecting for 4-10 hours, it needs 5 hours' notice to reach the CCP MLP - it takes 5 hours for the CT to get to its MLP and 3 hours for the ST; both need to be at MLP, so CCP lead time = 5 hrs
- PD evaluation knows that neither CCP physical unit have injected for 8 hours, and therefore the CCP will require 5 hours' notice to meet an MLP commitment

PD Process Overview (4) – Commitment

1. Hourly PD evaluation determines that a NQS generator should be committed to meet demand at lowest cost, necessitated by lead time
2. PD issues notification of a binding start-up instruction including assumptions for sync and ramp to MLP
3. An initial operational constraint is applied at MLP for MGBRT
4. MLP operational constraint may be extended by hourly PD runs

Right:

Example - Commitment period based on submitted generator data



PD Process Overview (5) – Post PD

- All resources must follow their RT dispatch instructions
- A committed NQS resource must take the following additional actions*:

1. Confirm receipt of binding start-up instruction and intended time of sync (for each resource, if CCP)
2. Synchronize resource(s) and ramp to MLP
3. Follow dispatch during MGBRT at MLP or greater as determined on a 5-minute basis by considering offered ramp rates – RT dispatch will be provided for CCP, if applicable
4. Continue to follow dispatch after MGBRT period if extended by hourly PD
5. Notify IESO of the expected de-sync time if not extended
6. Provide shut down notice to IESO upon receiving first dispatch below MLP, prior to ramping down
7. Ramp down as directed by IESO and according to dispatch

*Further details will be determined in the detailed design phase.

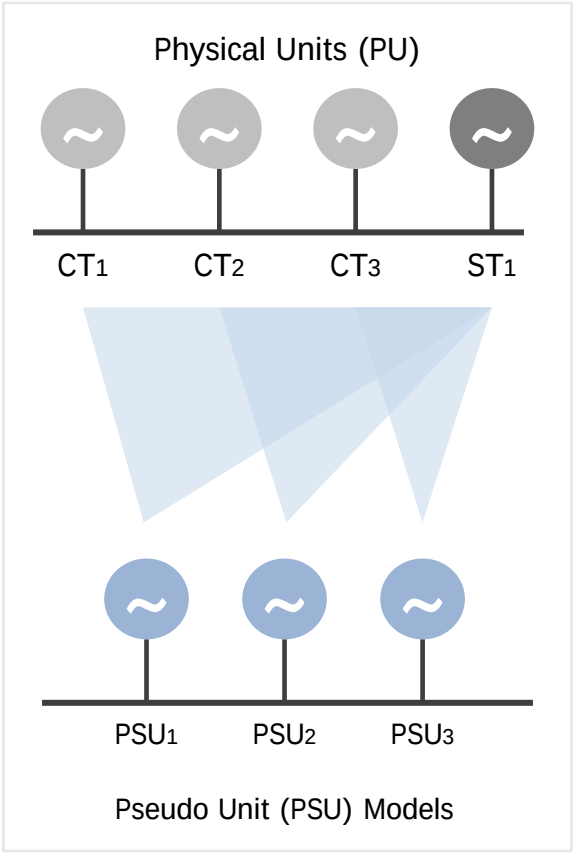
Stakeholder Feedback – Lead Time

Stakeholder Feedback:

- Lead time of the physical resources that make up a combined cycle plant (CCP) will differ from one another

IESO Response:

- It is understood that the physical resources will have different lead time than the CCP
- Lead time must be provided for the CCP if offering in PD timeframe as a CCP
- Lead time curve will provide the necessary data for PD evaluation at all operating states
- CCP will receive its own PD schedules and RT dispatch since modelling will be implemented in all timeframes (DA, PD, & RT)



Above : Current CC modelling approach

Stakeholder Feedback – Sync & Ramp (1)

Stakeholder Question:

- Will the advisory schedule include assumptions on sync and ramp for a commitment, or will the resource need to schedule its physical units to sync and ramp to meet the obligation?

IESO Response:

- Pre-dispatch advisory schedules will include sync/ramp assumptions; given complex interactions between lead time, sync time, and ramp rates, the method for determining PD advisory schedules for ramp to MLP will be determined in Detailed Design
- For real-time dispatch schedules, we expect that generators will continue to offer into the market to manage ramp to MLP

Stakeholder Feedback – Sync & Ramp (2)

Stakeholder Question:

- Will mandatory window offer submissions for ramp be permitted for the purpose of meeting a schedule?

IESO Response:

- The IESO does not intend to routinely allow offer changes during the mandatory window for ensuring a ramp schedule

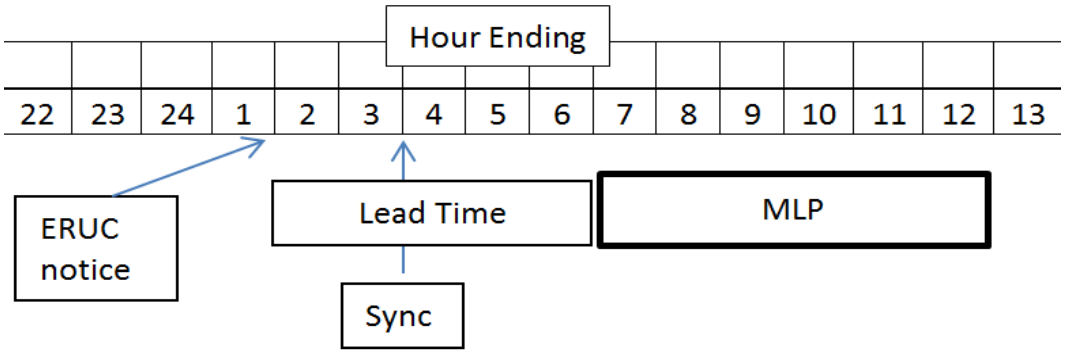
Stakeholder Feedback – Commitment Period

Stakeholder Question:

Where sync happens mid-hour for a top of the hour commitment, is the commitment period determined after sync?

IESO Response:

- No, time of sync will not impact the commitment period
- The beginning of the commitment period is set when the PD evaluation issues a binding start-up instruction with an initial operational constraint for MGBRT hours e.g. HE7-12



Stakeholder Feedback – Ramping Offline

Stakeholder Feedback:

- It is unclear how a generator would communicate ramp down to come offline

IESO Response:

- If PD does not extend the commitment, a generator will notify the CRO of expected de-sync time
- When a generator gets a first dispatch below MLP, it will advise the CRO of estimated shut down time
- Generators that need to plan shut down further in advance may offer at higher prices to indicate intent to come offline

Stakeholder Feedback – Ramp Mitigation

Stakeholder Question:

- How will ramp energy offers impact the mitigation criteria?

IESO Response:

- The thresholds for mitigating for uneconomic production will be determined during detailed design:
  - Lower ramp-up offers: If there is interaction between a low offer during ramp-up and mitigation thresholds, IESO will engage with stakeholders to address this issue
  - Higher ramp-down offers: A higher offer will be subject to assessment for market power, as previously discussed
    - if no market power, a generator will be able to ramp-down
    - if market power, generator may continue to operate or may submit outage information

DESIGN ELEMENT NO. 2: LOOK-AHEAD PERIOD (LAP)

Background – LAP Preliminary Decision

To reach the LAP preliminary decision, the IESO considered **reliability**:

- Ontario is not able to follow other jurisdictions' approaches with very short PD timeframes due to the resource mix
- A LAP evaluation of 17 hours is adequate to ensure reliability, considering lead time and MGBRT of the majority of NQS generators
- However, the LAP must run until end of day to correctly consider ELRs that have daily energy limits; therefore, the LAP needs to be at least 24 hours (HE1-24), running at 23:00 and publishing at 23:30
- Given morning ramp begins around 6:00, cold NQS generators required for reliability may need notice before 23:30
- For this reason, the first LAP that looks at hours of the next day must be at 20:00 which provides adequate notice for reliability reasons

Stakeholder Feedback – Initial LAP Timing

Stakeholder Feedback:

- Having expressed that software is a limiting factor for earlier PD optimization, the IESO should consider delaying the preliminary decision until a selected vendor can provide greater certainty of software capabilities

IESO Response:

- The deciding factor for this decision is **reliability** of the Ontario grid, ensuring that morning ramp and daily energy limits are considered
- Improved DAM & PD modelling for both CCPs and ELRs will provide more feasible schedules to support planning & risk management
- No change to the preliminary decision is recommended – the first PD run including the next day at 20:00 is sufficient to maintain reliability and enable efficient market participation
- To address the rare events where there are significant changes in system conditions before 20:00 that cannot be addressed by PD, the IESO has recommended a process to evaluate the need for additional commitments

DESIGN ELEMENT NO. 3: TIMING AND FREQUENCY OF RUNS

Recap – 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 will 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)

Stakeholder Feedback & IESO Response

Stakeholder Feedback:

- What criteria will the IESO use to evaluate whether additional commitments are required if it does not have the engine capability to run a parallel ERUC run during this period? Will lead time be the only factor considered in determining which resource is committed?

IESO Response:

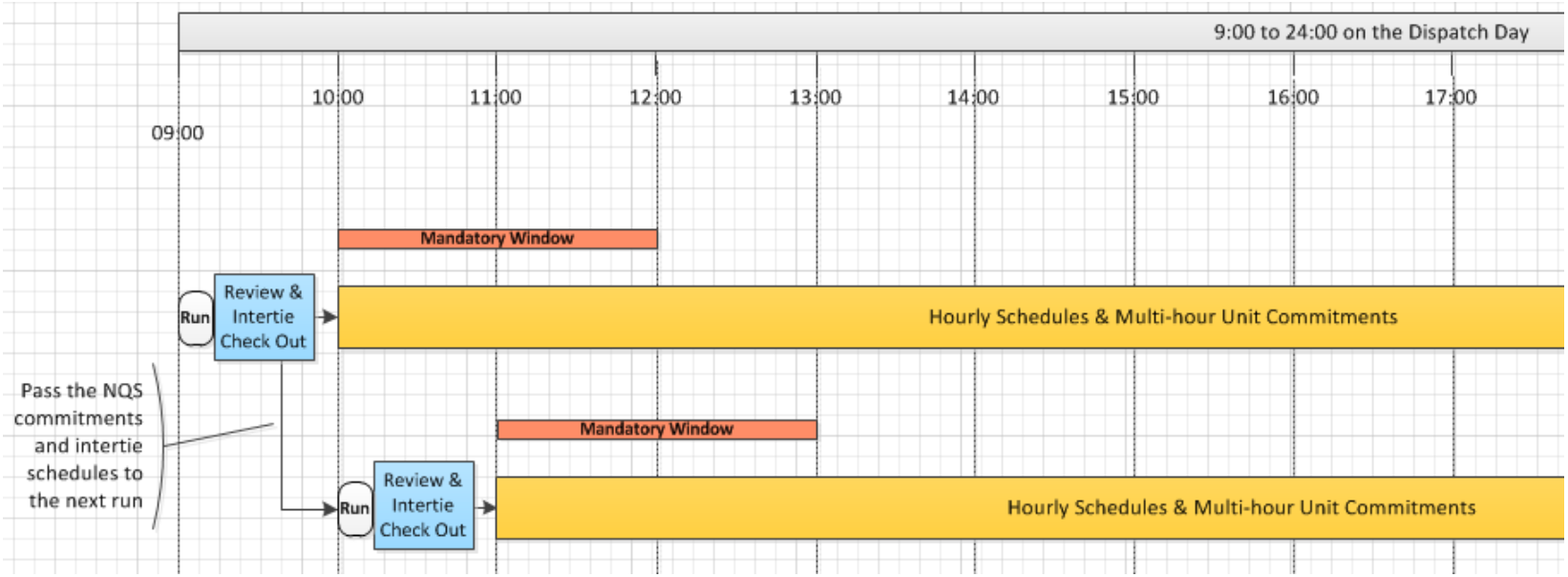
- Detailed design will identify consistent and transparent criteria for determining if additional commitments are required
- The purpose of this design element is to ensure reliability under the rare circumstance when a significant change in system conditions for the next day occurs that can not be addressed by the 20:00 pre-dispatch
- Additional commitments will only be issued if required to meet Ontario demand and/or reserve requirements

DESIGN ELEMENT NO. 5: INTERTIE TRANSACTIONS

Recap – Preliminary Decision, Option 3

Where the hour of the PD run is hour T:

- For T+1 and T+2 (mandatory window), 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



For illustrative purposes only

Stakeholder Feedback & IESO Response

Stakeholder Feedback:

- Since non-DAM intertie bids and offers will not be considered in PD runs outside of the T+2 timeframe and Ontario is generally a net exporter, how does the IESO expect its planning for SBG situations to change?

IESO Response:

- SBG is well anticipated day-ahead because it results from a combination of high baseload generation and relatively low levels of Ontario demand
  - SBG will be addressed through the DAM because the IESO expects more exports to participate in the DAM as compared to DACP
- Similar to today, intertie bids & offers can change prior to the mandatory window; therefore, non-DAM exports are uncertain for managing SBG

WRAP UP & NEXT STEPS

Wrap up & Next Steps

- Provide any further feedback by October 18

- What's coming up?
  1. Education & Awareness Building sessions
  2. Public release of ERUC Draft HLD - December

Acronyms

CCP	Combined Cycle Plant
CRO	Control Room Operator
DAM	Day-Ahead Market
DGD	Daily Generator Data
ELR	Energy Limited Resources
ERUC	Enhanced Real-time Unit Commitment
HE	Hour Ending
HLD	High Level Design
LAP	Look-Ahead Period
MGBRT	Minimum Generation Block Run-Time
MLP	Minimum Loading Point
NQS	Non-Quick Start
PD	Pre-Dispatch
PSU	Pseudo Unit
RT	Real-Time
SBG	Spare Baseload Generation

APPENDIX

Example, Part 1: LAP & Advisory Schedules

Example Scenario:

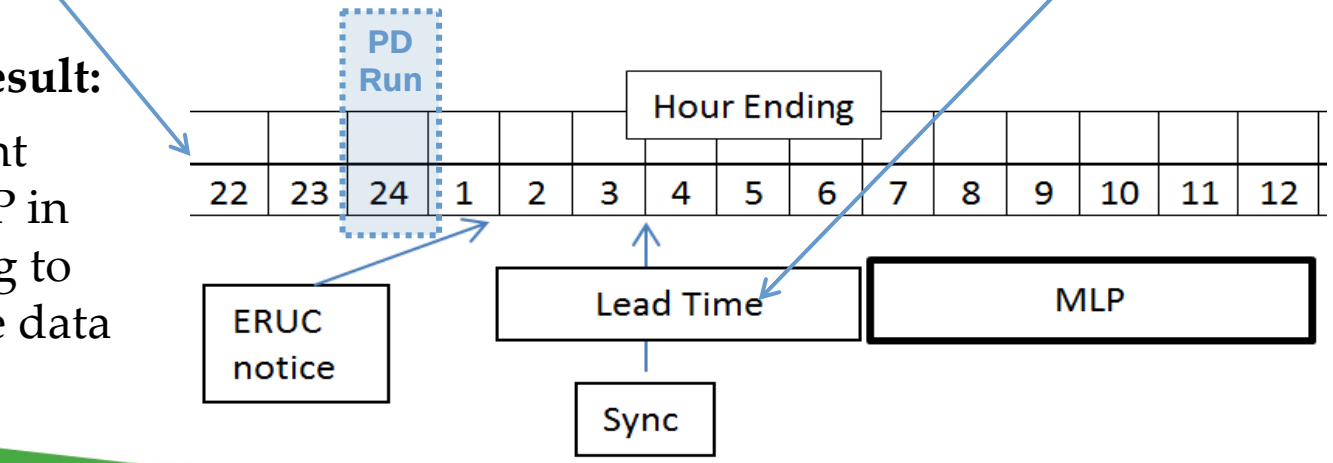
- Combined Cycle Plant (CCP) submits hourly dispatch data & daily generator data (DGD) with lead times
- **In HE24**, the hourly PD run publishes an advisory schedule for next-day LAP HE1-24 that indicates the CCP will be needed in **HE7**
- Lead time to reach MLP is **5 hours** as the CCP came offline in HE22 so the physical units will have been offline for about 8 hours by HE7

CCP DGD Lead Time Curve

Time Offline (Hrs)	Lead Time (Hrs)
< 4	3
4 to 10	*5*
> 10	10

PD Evaluation Result:

- No commitment needed for CCP in HE24 according to lead time curve data



Example, Part 2: PD Unit Commitment

Example Scenario – Cont'd:

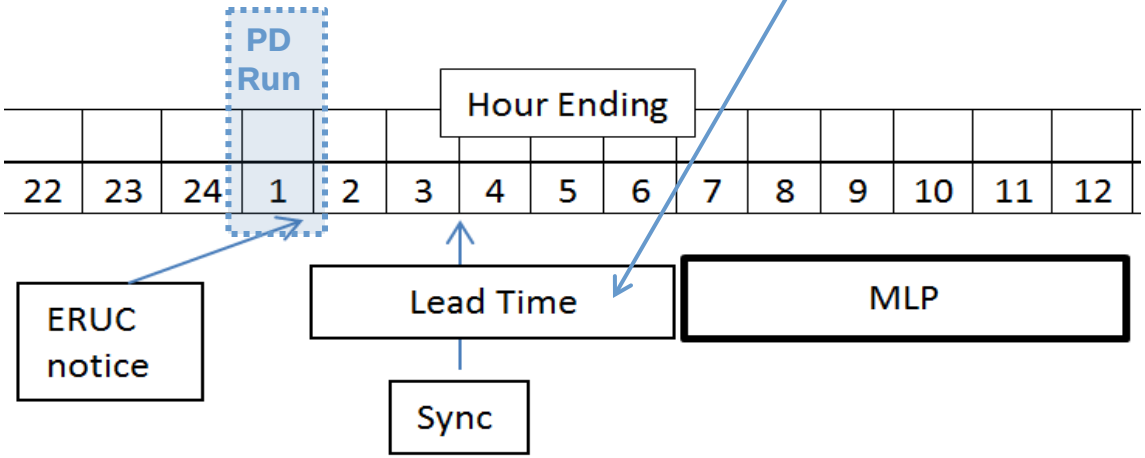
- **In HE1**, the PD run for LAP HE2-24 still shows an advisory schedule with the CCP at MLP in HE7
- Based on the **5-hour** lead time, the CCP will need HE2-6 to achieve MLP

PD Evaluation Result:

- Commits CCP in HE1 according to lead time curve data
- Sends CCP a binding start-up instruction including assumptions for sync/ramp
- Applies an operational constraint at MLP for MGBRT (HE7-12)

CCP DGD Lead Time Curve

Time Offline (Hrs)	Lead Time (Hrs)
< 4	3
4 to 10	*5*
> 10	10



Example, Part 3: Post Commitment

Once the CCP is committed, it will need to:

1. Confirm intention to sync e.g. beginning of HE4 (may differ for CT & ST) and then ramp in HE 4-6 to the CCP MLP by start of HE7
2. Operate to 5-minute dispatch at or above MLP during MGBRT (HE7-12)
3. Continue to follow dispatch at or above MLP if the commitment is extended to include HE 13 by the hourly PD run in HE12
4. Notify the CRO of expected de-sync time when the commitment is not extended by the hourly PD run
5. Provide shut down notice upon receipt of the first dispatch below MLP
6. Ramp down as directed