

SEPTEMBER 29, 2023

Market Renewal Program Implementation

Market Rules and Market Manuals: Market and System Operations

Q&A Session for Dispatchable Hydroelectric Resources

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Disclaimer

This document provides an overview of certain draft amendments to the market rules proposed in connection with the Market Renewal Program (MRP). The content of the proposed amendments is subject to further revision and the overview contained herein is provided for information purposes only. The information contained in this document shall not be relied upon as a basis for any commitment, expectation, interpretation and/or decision made by any market participant or other interested party. The market rules and market manuals, applicable laws, and other related documents will govern the future market. The IESO makes no representation or warranty, express or implied about the accuracy or completeness of the information contained herein.

Webinar Participation

- Ways to interact in today's webinar:
 - Questions encouraged at any point during the presentation
 - Raise your hand (click the "Raise hand" button in the top right corner) to let the host know you'd like to verbally ask a question or make a comment. The host will let you know when to unmute
 - Enter a written question/comment in the chat. The host will read it out for you
- Microphones should be muted at all times, unless the host has called on you to unmute yourself

Meeting Purpose

To provide stakeholders looking to participate in Ontario's energy markets as dispatchable hydroelectric resources with an overview of their participation in the future day-ahead market (DAM), pre-dispatch (PD) and real-time market (RTM) in accordance with the Market and System Operations (MSO) and Calculation Engines batches of market rule and market manual amendments

Engagement Timeline

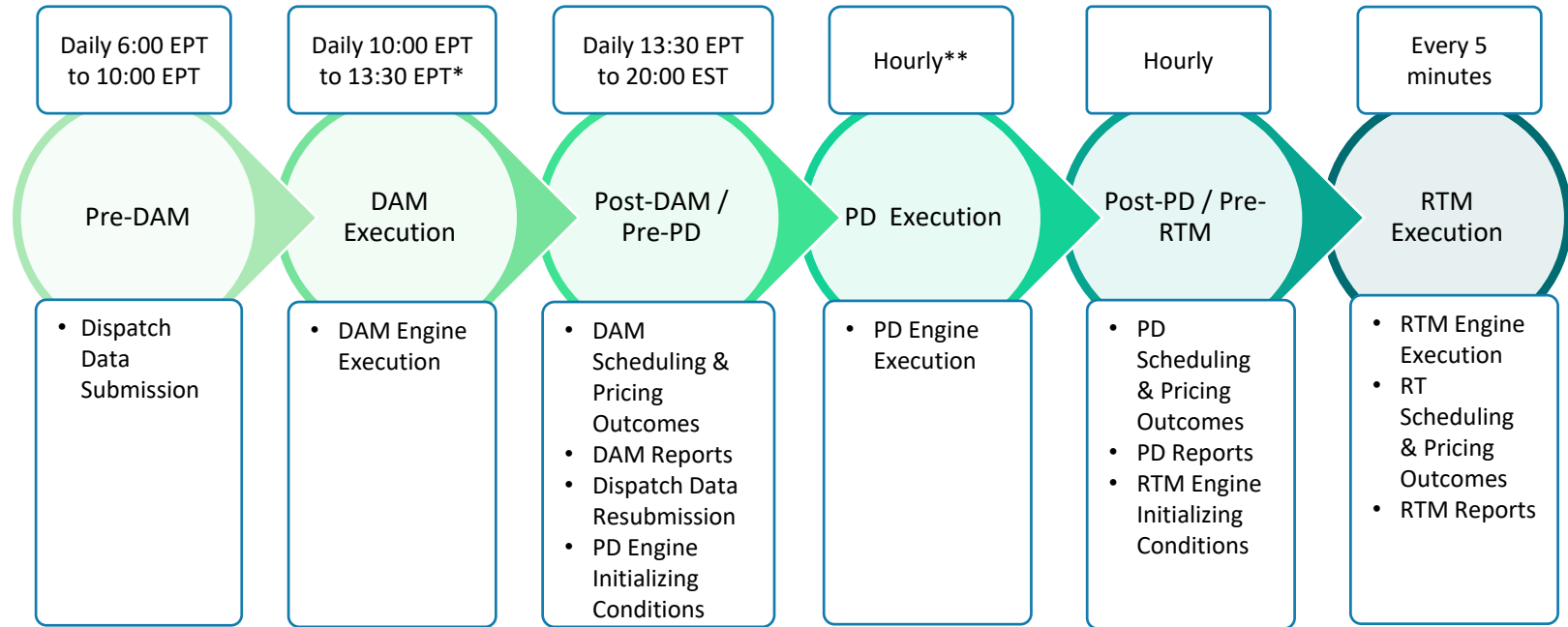
July 14: Draft MSO batch of market rule and market manual amendments published for stakeholder review

July 27 and 28: Webinars conducted to prepare market participants for their review of the MSO batch

Today: Q & A session that focuses on dispatchable hydroelectric resources navigating dispatch data submission and scheduling/pricing outcomes from day-ahead to real time

November 8: Feedback on MSO batch of market rule and market manual amendments due to the IESO

Q&A Session Scope for Hydroelectric Resources



* DAM execution can be extended until 15:30 EPT

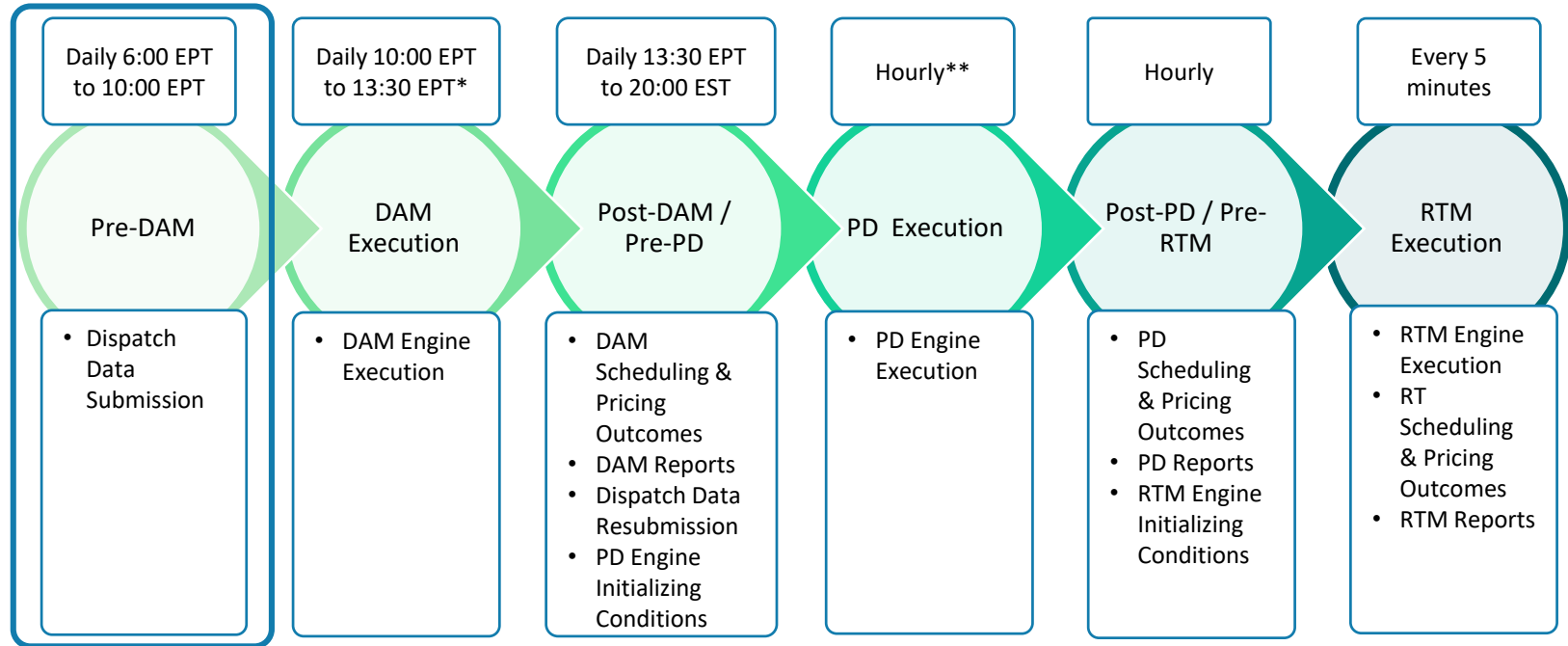
** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

Assumptions

Stakeholders are already familiar with:

- the relevant MSO batch materials that pertain to the participation of dispatchable hydroelectric resources in the future DAM and RTM
- the future authorization, registration and settlement market rules and manuals that pertain to dispatchable hydroelectric resources
- the timelines and general mechanics of the future DAM, PD and RTM engines
- the dispatch data applicable to dispatchable hydroelectric resources, what it represents and the purpose it serves (as described in the Offers, Bids and Data Inputs Detailed Design)

Pre-DAM



* DAM execution can be extended until 15:30 EPT

** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

Dispatch Data Submission Considerations

Market participants (MPs) should be mindful of the following when submitting dispatch data for dispatchable hydroelectric resources:

- Dispatch data parameters and their applicability within each engine
- Availability Declaration Envelope (ADE)
- Dispatch data validations
- Implications of ex-ante market power mitigation (MPM)
- DAM engine initialization features
- Pre-DAM reports

Dispatch Data Parameters and Engine Applicability

| Dispatch Data Parameter | Dispatch Data Type | New or Existing | Single Resource (no forebay registered) | Cascade Group (forebay registered) | DAM | PD | RTM |
|-----------------------------|--------------------|-----------------|---|------------------------------------|-----|----|-----|
| Energy offer | Hourly | Existing | ✓ | ✓ | ✓ | ✓ | ✓ |
| Operating reserve offers | Hourly | Existing | ✓ | ✓ | ✓ | ✓ | ✓ |
| Hourly energy ramp rate | Hourly | Existing | ✓ | ✓ | | | ✓ |
| Operating reserve ramp rate | Hourly | Existing | ✓ | ✓ | ✓ | ✓ | ✓ |
| Reserve loading point | Hourly | Existing | ✓ | ✓ | ✓ | ✓ | ✓ |
| Minimum hourly output (MHO) | Hourly | New | ✓ | ✓ | ✓ | ✓ | ✗ |
| Hourly must run (HMR) | Hourly | New | ✓ | ✓ | ✓ | ✓ | ✓ |

Dispatch Data Parameters and Engine Applicability

| Dispatch Data Parameter | Dispatch Data Type | New or Existing | Single Resource (no forebay registered) | Cascade Group (forebay registered) | DAM | PD | RTM |
|--|--------------------|-----------------|---|------------------------------------|-----|----|-----|
| Daily energy ramp rate | Daily | New | ✓ | ✓ | ✓ | ✓ | |
| Forbidden regions | Daily | New | ✓ | ✓ | ✓ | ✓ | ✓ |
| Linked resources | Daily | New | | ✓ | ✓ | ✓ | |
| Time lag | Daily | New | | ✓ | ✓ | ✓ | |
| MWh ratio | Daily | New | | ✓ | ✓ | ✓ | |
| Minimum daily energy limit (MinDEL) | Daily | New | ✓ | ✓ | ✓ | ✓ | ✓* |
| Maximum daily energy limit (MaxDEL) | Daily | Existing | ✓ | ✓ | ✓ | ✓ | |
| Maximum number of starts per day (MNSPD) | Daily | Existing | ✓ | ✓ | ✓ | ✓ | |

*MinDEL is only respected by the RTM engine if it is binding in the previous PD engine run

Availability Declaration Envelope (ADE)

- ADE will continue to apply in the renewed market
- MPs must submit energy offers into the DAM for every hour they intend to participate in the RTM
- The allowance to expand the ADE in the RTM is being increased **from** the lesser of **2%** of the ADE or 10 MW **to** the lesser of **15%** of the ADE or 10 MW

Dispatch Data Validations

- Dispatch data submissions must adhere to a number of rules documented within the MSO batch in order to be accepted as valid. Examples include:

| Validation | Description | Example |
|-------------------|---|--|
| General | Dispatch data format aligns with how the engines read the data | Offer laminations must be monotonically increasing |
| Registration | Dispatch data submissions fall within registered quantities | The quantities submitted for the lower and upper limits of a forbidden region are within the bounds of the registered region |
| MPM | Dispatch data submissions are within permissible reference level thresholds | Operating reserve ramp rate must be greater than or equal to half of the registered reference level |
| Cross validations | Related dispatch data are not in conflict with one another | The MaxDEL submitted is greater than or equal to the MinDEL submitted |

- If one or more validations fail, error issued and resubmission required

Validations for New Dispatch Data

| Validation | Description |
|-----------------------------|---|
| Minimum Hourly Output (MHO) | <ul style="list-style-type: none">• The MHO value must be less than or equal to the largest quantity in energy offer• Second PQ pair quantity must exceed the MHO value• The sum of MHO values for a dispatch day must be less than or equal to MaxDEL |
| Hourly Must Run (HMR) | <ul style="list-style-type: none">• The HMR value must be less than or equal to the largest quantity in energy offer• The sum of HMR values for a dispatch day must be less than or equal to MaxDEL |
| Forbidden Regions | <ul style="list-style-type: none">• The upper limit for a forbidden region is greater than the lower limit• The forbidden regions values submitted must be ascending• The number of forbidden regions submitted must be less than or equal to the number of registered forbidden regions• The lower and upper limits submitted are within the bounds of the registered regions |

Validations for New Dispatch Data (cont'd)

| Validation | Description |
|-------------------|--|
| Time Lag | <ul style="list-style-type: none">• The time lag submitted between adjacent upstream and downstream forebays must be less than or equal to the registered time lag between those forebays• The time lag submitted between non-adjacent upstream and downstream forebays must be less than the sum of the registered time lags between the upstream and downstream forebays, including any intermediary forebays |
| Linked Resources | <ul style="list-style-type: none">• An upstream forebay may only submit a downstream linked forebay that is registered as downstream within the cascade group |
| MinDEL and MaxDEL | <ul style="list-style-type: none">• The MinDEL submitted must be less than or equal to the sum of hourly energy offer quantities submitted for the dispatch day; and the MaxDEL submitted• The MaxDEL submitted must be greater than or equal to the MinDEL submitted• The resources registered with the same forebay are collectively bound by the same MinDEL and MaxDEL submitted for the forebay |

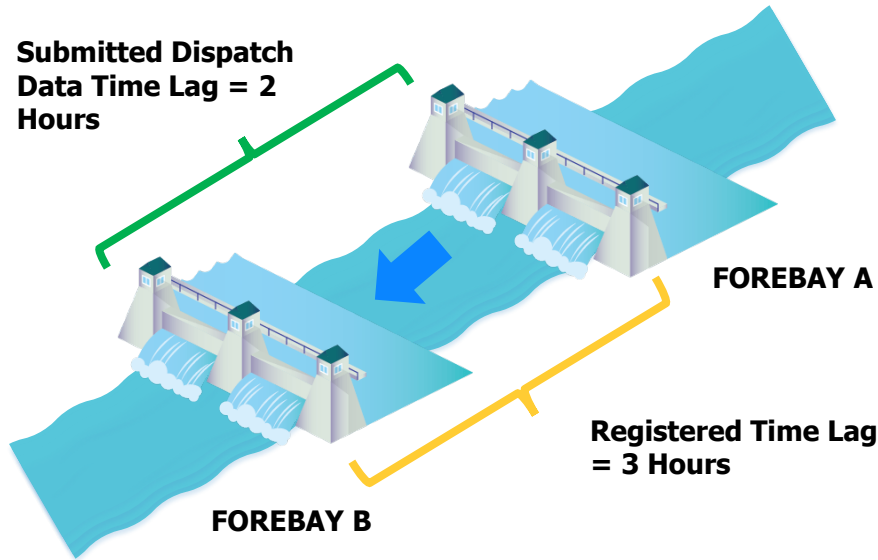
Example: HMR Validations

Scenario: MP submits HMR values for hour ending (HE) 17 – 20 of the dispatch day

| Dispatch Data Submitted | HE17 | HE18 | HE19 | HE20 | HMR Validation | Result |
|---------------------------------|----------|--------|--------|--------|------------------------------------|-------------------------------------|
| HMR | 200 MW | 200 MW | 200 MW | 200 MW | HMR \leq Largest Offer Quantity? | Yes for HE17 – HE19; No for HE20 |
| Energy Offer (largest quantity) | 250 MW | 300 MW | 200 MW | 150 MW | | |
| MaxDEL | 1000 MWh | | | | Sum of HMR values \leq MaxDEL? | Yes |

Example: Time Lag Validation

Scenario: MP has a 3 hour time lag registered between upstream forebay A and downstream forebay B



Dispatch data passes validation as the submitted time lag between forebay A and forebay B is less than the registered time lag value between these forebays.

Implications of Ex-Ante MPM

- Ex-ante MPM applies for energy and operating reserve offers in the DAM and PD engines for dispatchable resources
 - Mitigation decisions from PD are carried forward into RTM
- MPs may submit energy and operating reserve offer prices above their registered reference levels with an understanding that such offer prices are subject to ex-ante mitigation by the DAM and PD engines (ex-ante MPM overview discussed next)

Overview of Ex-Ante Mitigation

- 1** Existence of market power condition restricting competition
Ensures mitigation is only performed if required
- 2** **Conduct Test:** Check if submitted offer prices are within the acceptable tolerance
If 'pass': no mitigation is needed
If 'fail': submitted offers are replaced with reference levels
- 3** **Price Impact Test:** Ensure the difference between LMP calculated with submitted offer and the one calculated using reference levels is within acceptable tolerance
If 'pass': no mitigation is needed
If 'fail': the resulting LMPs and schedules are based on reference levels

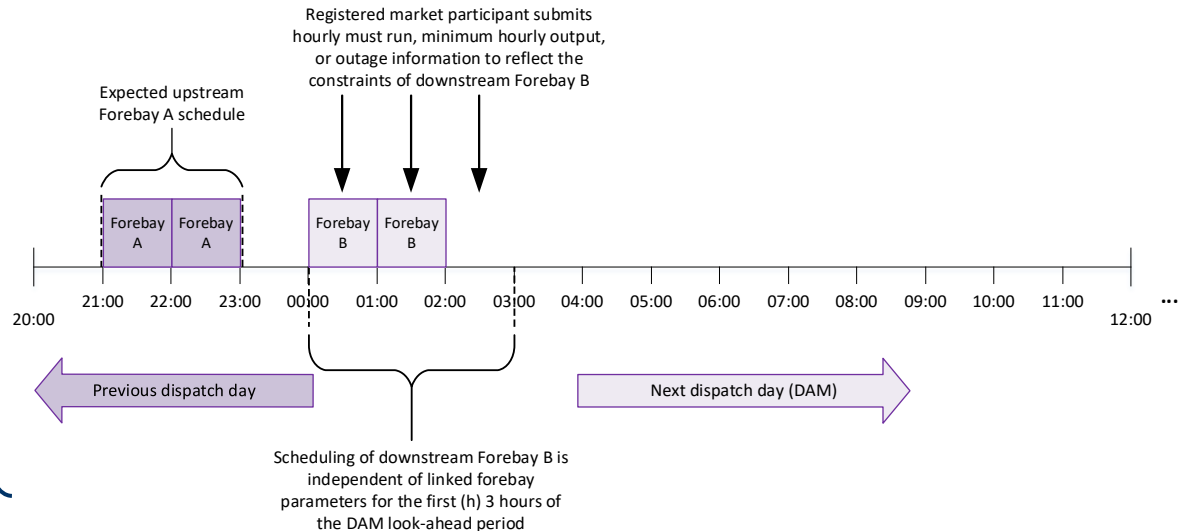
DAM Initialization Features Relevant for Hydro

- MPs submitting dispatch data for dispatchable hydroelectric resources should also be mindful that the DAM engine is unable to respect time lag and MWh ratios submitted for linked forebay resources over midnight from one dispatch day to the next
- MPs are expected to manage such requirements using other available dispatch data, such as energy offers, hourly must run quantities, minimum hourly output, and/or outages (sample scenario discussed next)

Example: Linked Forebays Over Midnight in DAM

Scenario: MP has a 3 hour time lag and a MWh ratio of 1 between upstream forebay A and downstream forebay B

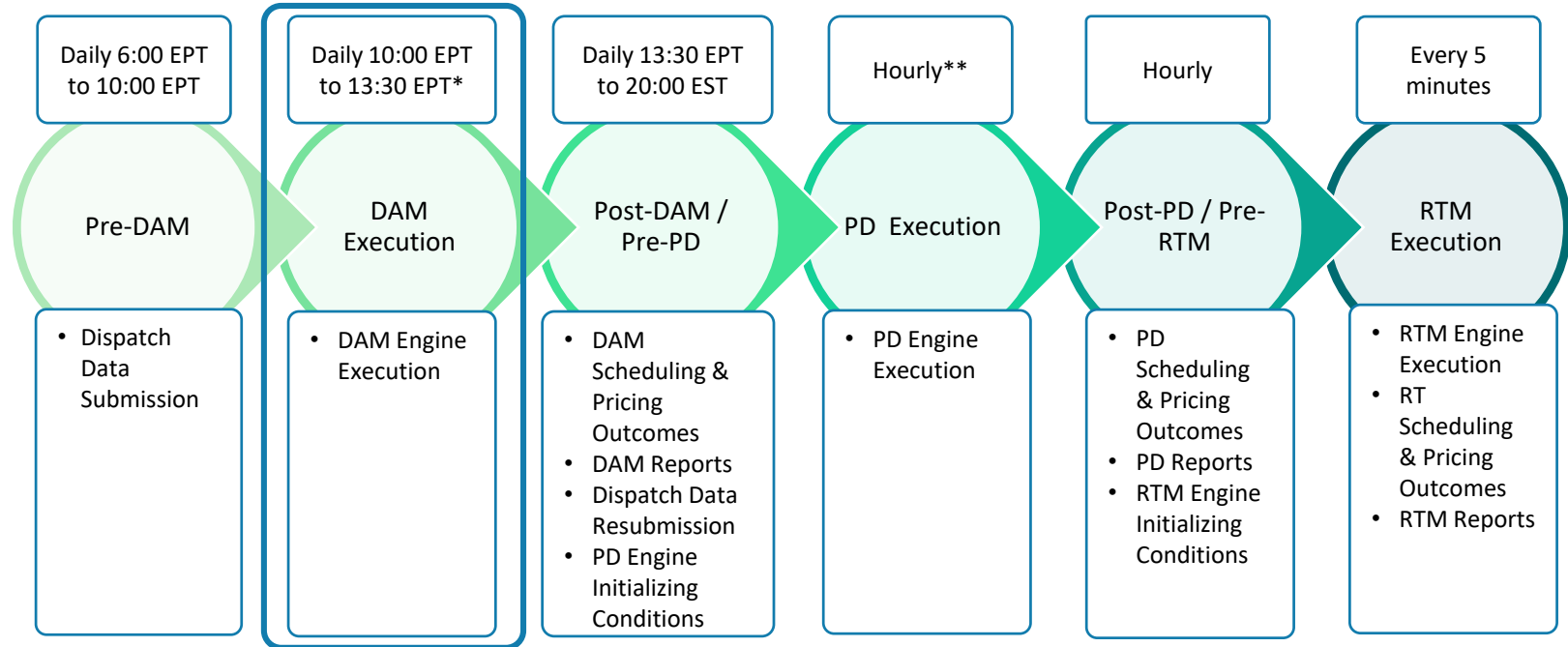
For the first “h” hours of the dispatch day, where “h” is the time lag value submitted, the time lag and corresponding MWh ratios between forebay A and forebay B are not respected by the DAM engine for forebay B based on the previous day’s PD schedule for forebay A



Pre-DAM Reports

| Report | New or Existing | Public or Private | Description |
|---|-----------------|-------------------|---|
| Adequacy Report | Existing | Public | Provides overall system conditions including any expected surplus/shortfalls, published at varies times throughout the day-ahead and pre-dispatch timeframes |
| Day-Ahead Area Reserve Constraints Report (Pre-DAM) | Existing | Public | Hourly maximum and minimum constraints for the area operating reserve regions expected to be used by the DAM engine, published daily at approximately 9:00 EPT |
| Day-Ahead Financial Reference Level Values Report | New | Private | Reference level values applicable for each resource type to be used by the DAM engine, issued by approximately 6:00 EPT Updated at approximately 09:30 EPT, reflecting changes provided by the MP for the dispatch day |

DAM Execution



* DAM execution can be extended until 15:30 EPT

** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

DAM Engine Execution Overview

Pass 1: Market Commitment and Market Power Mitigation

- Determines an initial set of schedules and prices to meet average demand
- Energy and operating reserve offers subject to ex-ante MPM, if required



Pass 2: Reliability Scheduling and Commitment

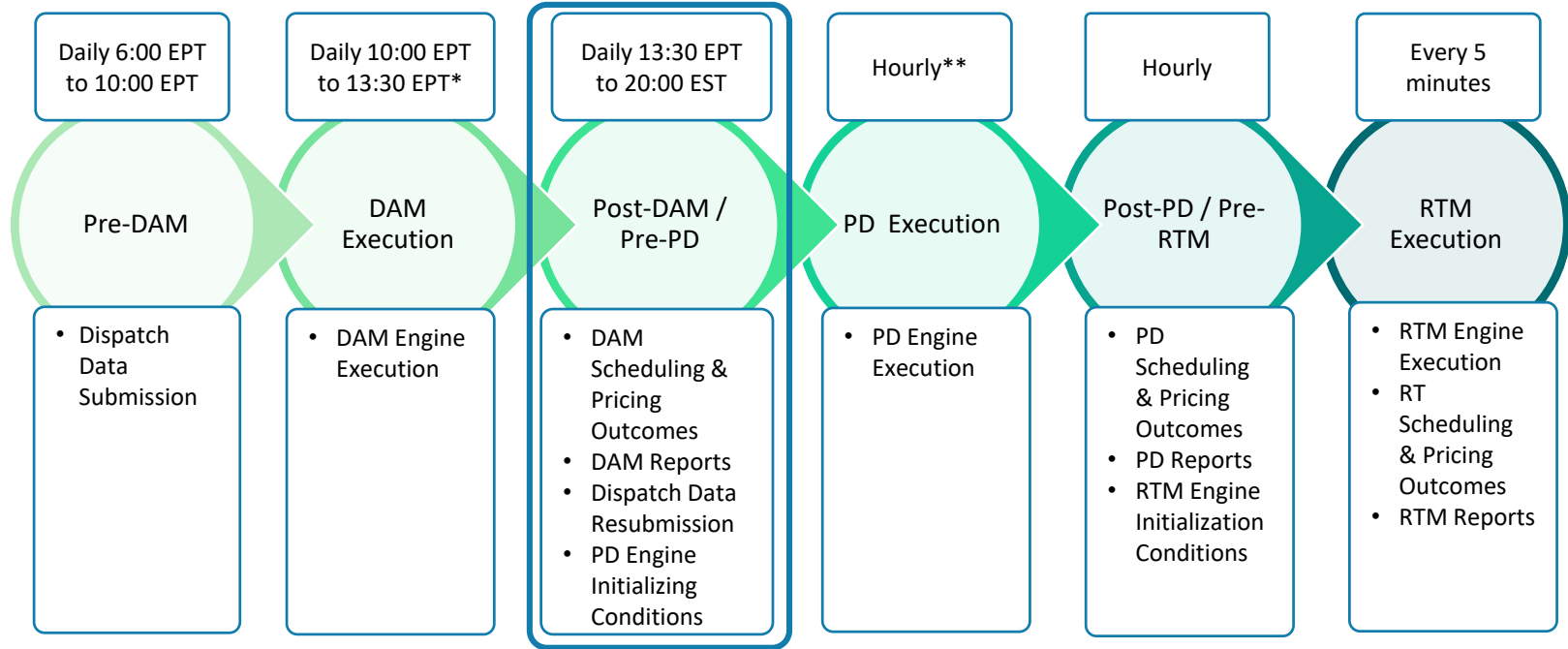
- Determines whether additional eligible non-quick start (NQS) resources need to be committed to meet peak demand
- Reference levels from Pass 1 used if mitigation applied



Pass 3: Day-Ahead Market Scheduling and Pricing

- Determines a final set of schedules and prices to meet average demand
- Reference levels from Pass 1 used if mitigation applied

Post-DAM / Pre-PD



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DAM Scheduling and Pricing Outcomes

- DAM energy and operating reserve schedules for dispatchable hydroelectric resources are produced hourly similar to today's DACP. Key input factors that may influence differences in scheduling and pricing outcomes relative to DACP include:
 - Evaluation of new dispatch data for various resources
 - Application of ex-ante MPM
 - Constraint violation prices
- Corresponding prices are produced hourly as locational marginal prices (LMPs) at each resource location (i.e., the same location as the schedule)
- DAM schedules and corresponding LMPs are used for settlement

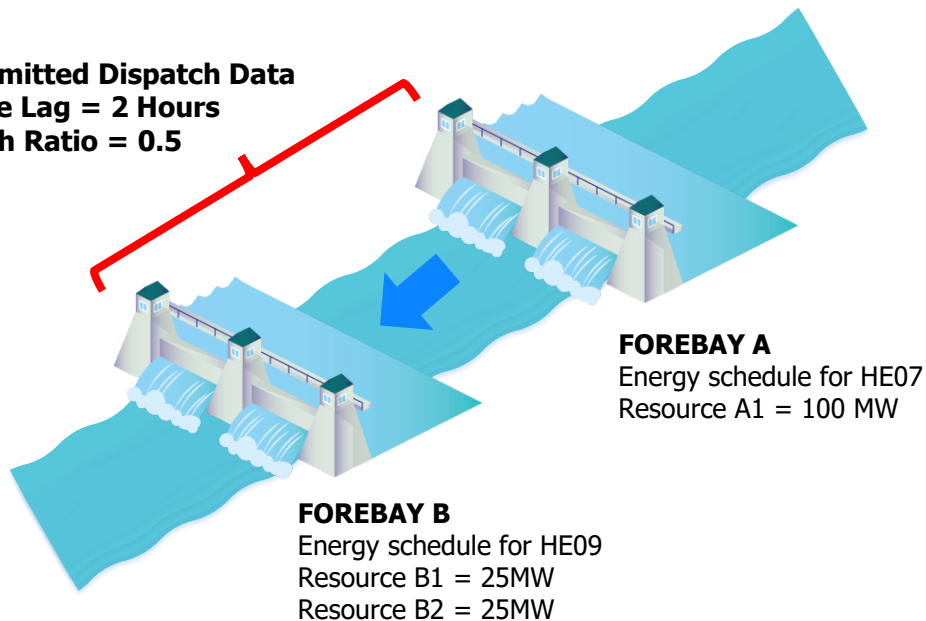
DAM Scheduling and Pricing Outcomes (cont'd)

| DAM Hourly Schedule | Outcomes | Dispatchable Hydroelectric Resources |
|---------------------|-------------------------------------|--------------------------------------|
| Energy | Schedule produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation | ✓ |
| | Schedule + LMP used for settlement | ✓ |
| Operating reserve | Schedule produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation | ✓ |
| | Schedule + LMP used for settlement | ✓ |

Example: Linked Forebay Scheduling Outcomes

Scenario: MP submits time lag and MWh ratio dispatch data for a cascade group with two forebays. Forebay A consists of one resource, A1, while forebay B consists of two resources, B1 and B2

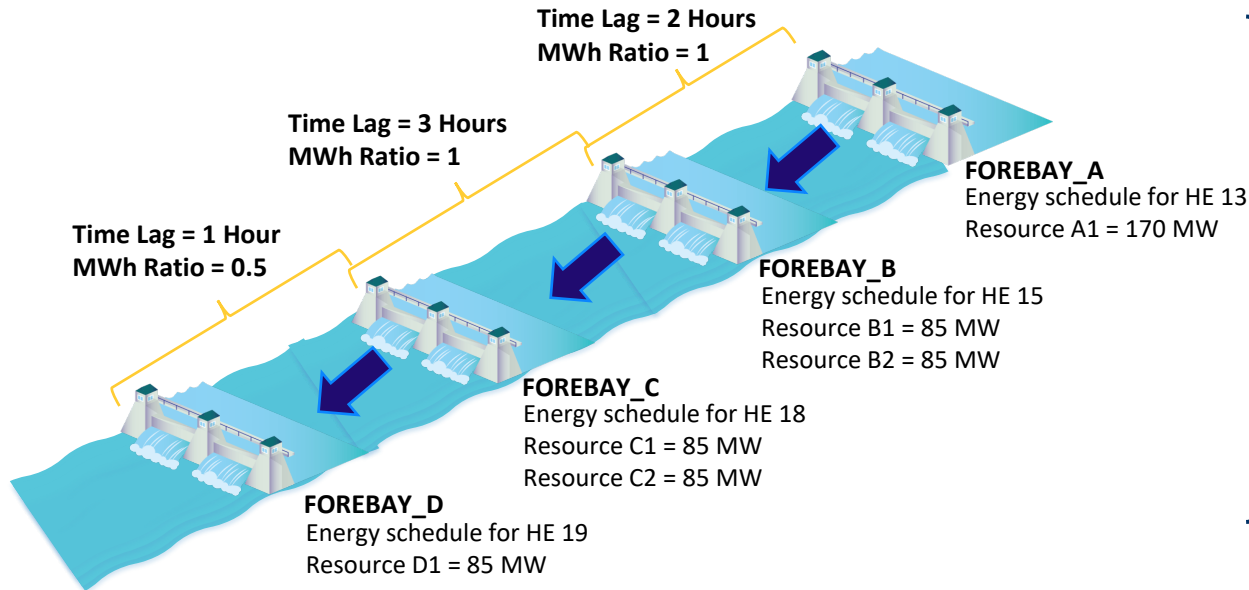
Submitted Dispatch Data
Time Lag = 2 Hours
MWh Ratio = 0.5



The cascade group is scheduled in consideration of the submitted linked forebay, time lag and MWh ratio. The timing of scheduling and sum of the individual resources in forebay B meet the requirements of the submitted dispatch data.

Example: Cascade Group Scheduling Outcomes

Scenario: MP submits time lag and MWh ratio dispatch data for a cascade group with four forebays. Forebays A and D consists of one resource, A1 and D1, respectively, while forebays B and C consists of two resources, B1 and B2 and C1 and C2.

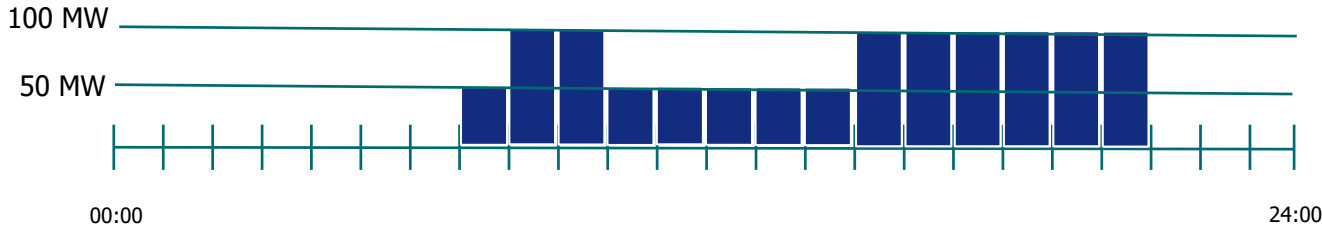


The cascade group is scheduled in consideration of the submitted linked forebays, time lags and MWh ratios. The timing of scheduling and energy schedules (including the sum of the individual resources in forebays B and C) meet the requirements of the submitted dispatch data.

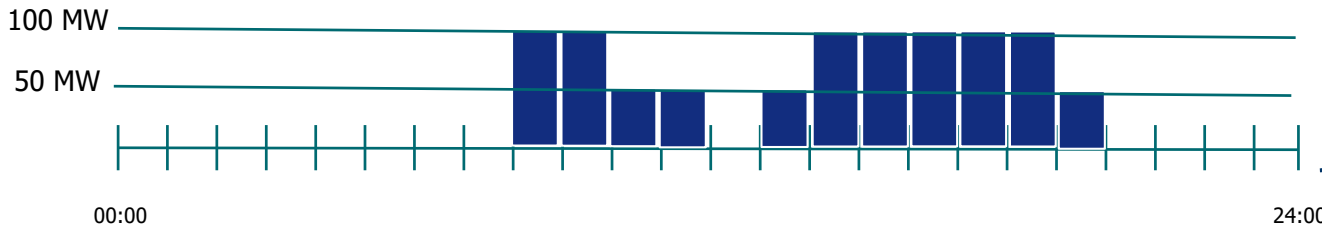
Example: Forebay MaxDEL Scheduling Outcomes

Scenario: MP submits a MaxDEL of 2000 MWh for a forebay that consists of two resources, B1 and B2.

DAM Energy Schedule Resource B1



DAM Energy Schedule Resource B2



The total energy scheduled on resource B1 is 1100 MWh. The total energy scheduled on resource B2 is 900 MWh. The total energy scheduled on B1 and B2 (1100 MWh + 900 MWh) respects the MaxDEL for the forebay (≤ 2000 MWh).

DAM Constraint Violation Prices

- Constraint violation prices are currently used in DACP to determine schedules
- For MRP, a new and separate set of constraint violation prices will be used to determine LMPs

| Constraint Violation Prices for DAM Scheduling | Constraint Violation Prices for DAM Pricing |
|--|--|
| <ul style="list-style-type: none">• Informational only• Constraint violation prices are used to prioritize which violations to resolve first where multiple constraints are violated and insufficient MP resources are available to resolve | <ul style="list-style-type: none">• Used for settlement• Used to determine LMPs that reflect the value of resolving a constraint violation where insufficient MP resources are available to do so |

- The methodology for determining both sets of constraint violation prices are documented in the market manual 4.2 and 4.3 appendices. While the actual values used for scheduling are documented, the actual values to be used for pricing will be determined before go-live

DAM Reports

| Report | New or Existing | Public or Private | Description |
|---|-----------------|-------------------|--|
| DAM Hourly Energy LMP Report | New | Public | LMPs for energy, including LMP components ¹ for all generator and load schedule locations, published after DAM completion |
| DAM Hourly Operating Reserve LMP Report | New | Public | LMPs for operating reserve, including LMP components ¹ for all eligible generator and load schedule locations, published after DAM completion |
| Day-Ahead Area Reserve Constraints Report | Existing | Public | Hourly maximum and minimum constraints for the area operating reserve regions used by the DAM engine, published at approximately 13:30 EPT |
| Real-time Financial Reference Level Values Report | New | Private | Reference level values to be used by the PD and RTM engines based on DAM results, issued daily at 14:00 EPT |
| Day-Ahead Scheduled Energy and Operating Reserve | Existing | Private | Hourly DAM energy and operating reserve schedules, issued after DAM completion. Also indicates whether mitigation was applied and the relevant constrained area condition. |
| Dispatch Data Report for DAM Scheduling Process | New | Private | Daily confirmation of an MP's daily and hourly dispatch data submitted into the DAM, issued after DAM completion |

¹ For energy LMP, components include loss and congestion prices. For operating reserve LMP, components include congestion price

Dispatch Data Resubmission

- All MPs are restricted from revising their submitted dispatch data during DAM engine execution (i.e., the DAM restricted window)
- After DAM completion:
 - Hourly dispatch data may be revised ahead of the first PD run and subsequent PD runs, up until the same two-hour mandatory window that MPs are familiar with in today's market; and
 - Daily dispatch data may be revised up to and within the two-hour mandatory window as long as a valid reason code is submitted, i.e. safety of any person, damage to equipment and violation of any applicable law (SEAL)
- PD engine initialization conditions should also be considered when resubmitting dispatch data

PD Engine Initializing Conditions

- MPs submitting revisions to dispatch data for use by the PD calculation engine should be aware of the following PD initialization conditions:
 - Evaluation of daily dispatch data over midnight boundary
 - Tracked values

PD Evaluation of Daily Dispatch Data over Midnight

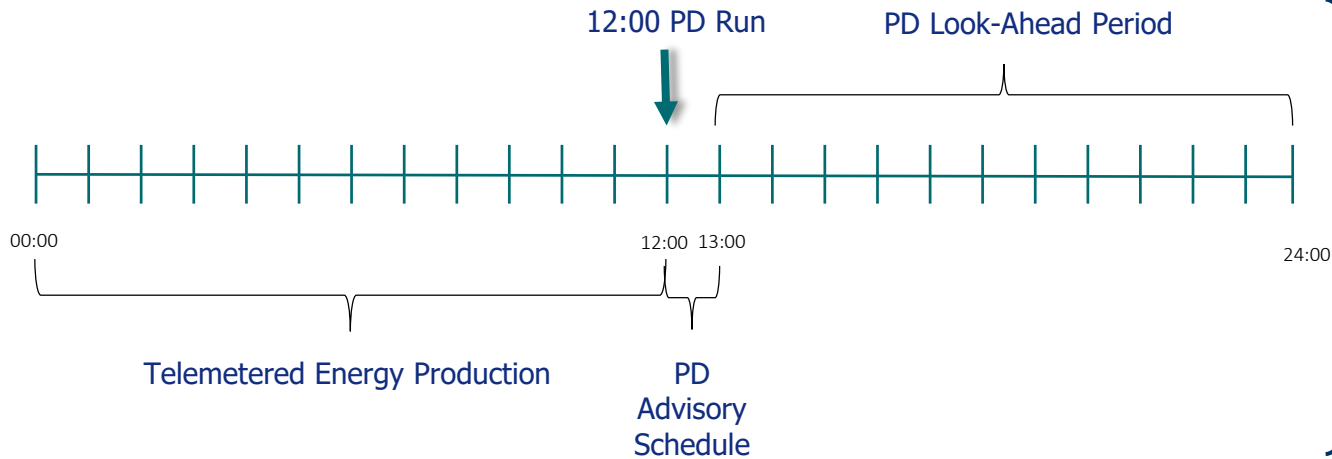
| Predispatch Run | Look Ahead Period | Daily Dispatch Data Used |
|-----------------|---|---|
| 00:00 – 19:00 | Hours remaining in the current day | Dispatch data submitted for current day |
| 20:00 – 22:00 | Hours remaining in the current day & all 24 hours of the next day | Dispatch data submitted for current day for HE 22 – 24, except linked forebays, time lag, MWh ratio and daily energy ramp rate where dispatch data for next day will be evaluated Dispatch data submitted for next day for all hours of next day |
| 23:00 | All 24 hours of the next day | Dispatch data submitted for next day |

Pre-Dispatch Tracked Values

- Pre-dispatch tracks energy production and starts in order to produce schedules that respect the submitted dispatch data, including cascade groups, minDEL, maxDEL and MNSPD
 - Tracked energy uses a combination of telemetered values and PD advisory schedule
- Market participants will receive the tracked data via confidential reports
- In the rare case where there is a discrepancy between tracked and actual values, market participants should update their dispatch data to correct the discrepancy and notify the IESO

Example: PD Energy Tracking

Scenario: The 12:00 run of PD uses tracked energy production in order to schedule the remaining look-ahead period

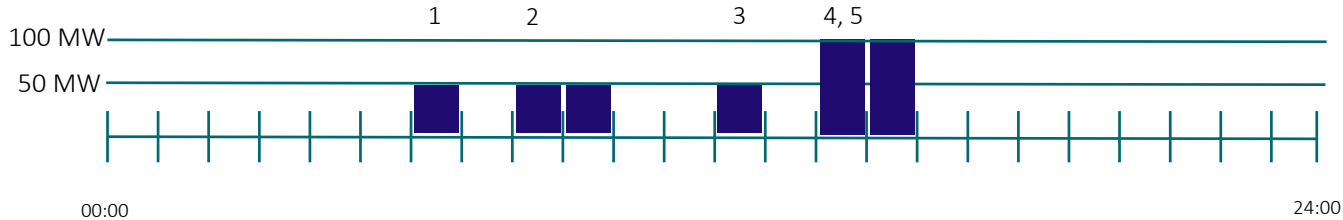


The 12:00 PD engine run uses telemetered energy production from HE 01 to HE 12 and the PD advisory schedule value for HE 13 to establish the total energy production at the start of the look-ahead period

Example: MNSPD Tracking

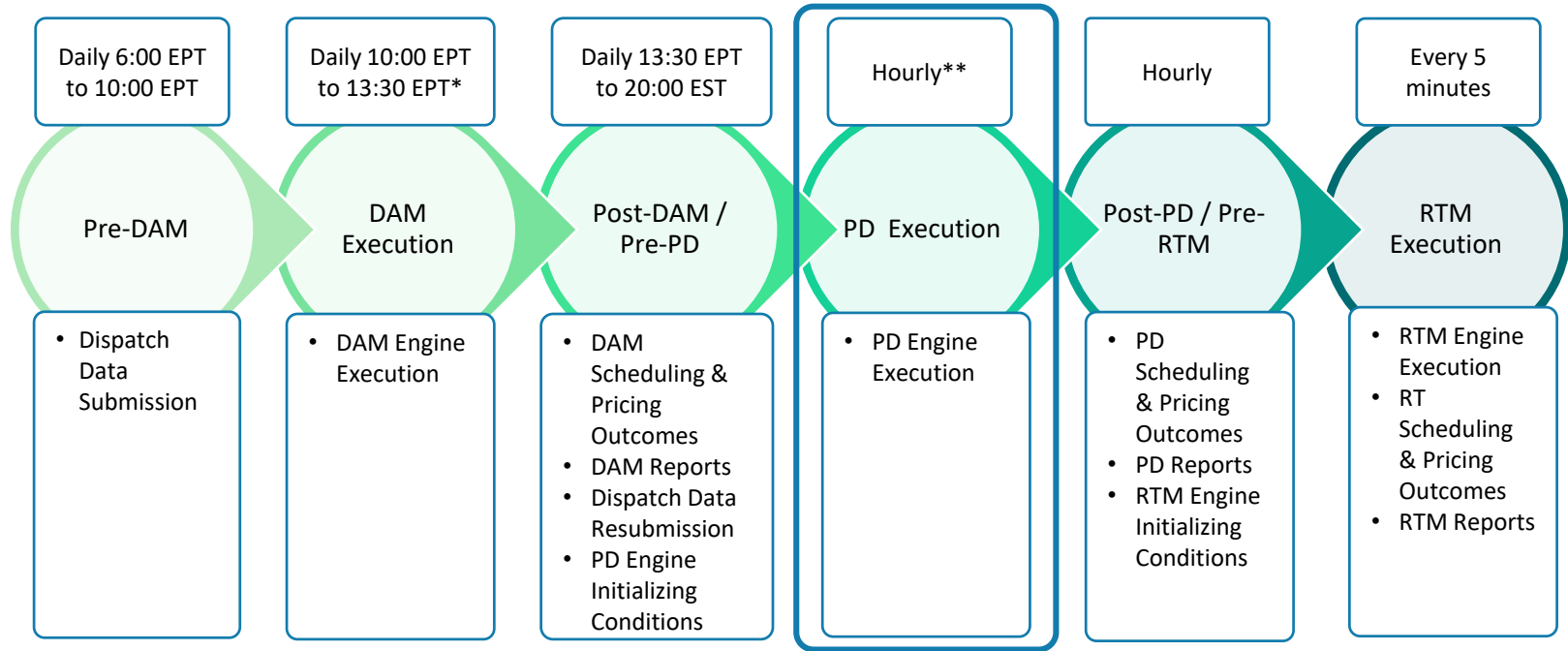
Scenario: The MP has an aggregated resource with two units. There are two registered start indication values.

Registered start indication value 1: 1 MW
Registered start indication value 2: 100 MW
Submitted MNSPD: 5



A start is counted when the energy production exceeds a registered start indication value

PD Execution



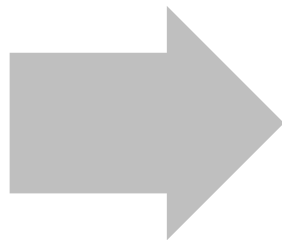
* DAM execution can be extended until 15:30 EPT

** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

PD Engine Execution Overview

PD Engine

- Determines schedules and prices to meet composite demand
- New, existing and modified energy and operating reserve offers relative to DAM are subject to ex-ante MPM, if required



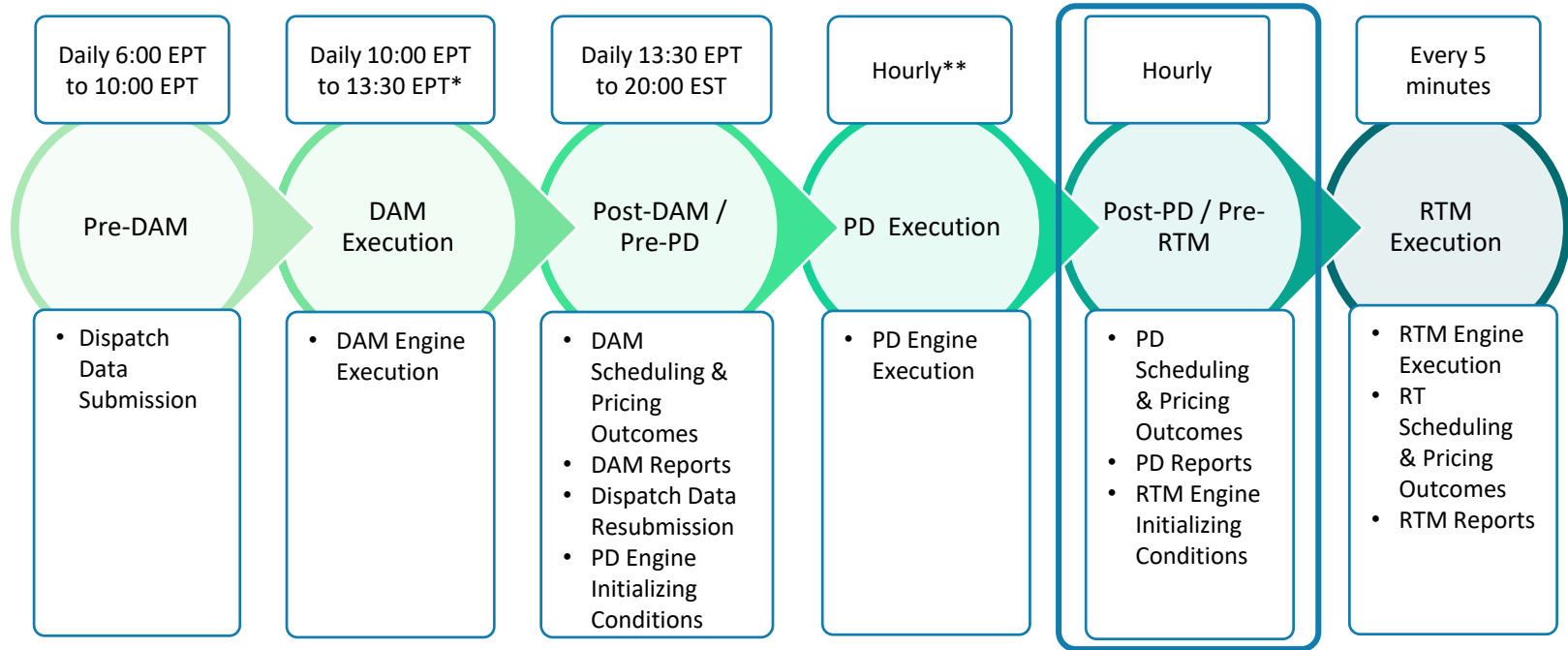
Subsequent Runs of the PD Engine

- Continues to determine schedules and prices to meet composite demand
- Mitigated energy and operating reserve offers are passed from one PD run to the next

PD Engine Execution (cont'd)

- If energy and/or operating reserve offers are mitigated by the PD engine, reference level values are used in lieu of offer values for all subsequent PD runs
- MPs may request updates to their reference level values between PD runs if their fuel costs change as per MPM market manual 14.2. Updated reference level value will be used by subsequent PD runs

Post-PD / Pre-RTM



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** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

PD Scheduling and Pricing Outcomes

- PD energy and operating reserve schedules for dispatchable hydroelectric resources are produced hourly similar to today
- Corresponding prices are produced hourly as LMPs at each resource location
- As discussed for DAM, key input factors that may influence differences in scheduling and pricing relative to today's PD include:
 - Evaluation of new dispatch data for various resources
 - Application of ex-ante MPM
 - Constraint violation prices
- PD schedules and corresponding LMPs for dispatchable hydroelectric resources are NOT used for settlement

PD Scheduling and Pricing Outcomes (cont'd)

| PD Hourly Schedule | Outcomes | Dispatchable Hydroelectric Resources |
|--------------------|-------------------------------------|--------------------------------------|
| Energy | Schedule produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation | ✓ |
| | Schedule + LMP used for settlement | ✗ |
| Operating reserve | Schedule produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation | ✓ |
| | Schedule + LMP used for settlement | ✗ |

PD Constraint Violation Prices

- The constraint violation prices discussed for DAM scheduling and pricing also apply to PD scheduling and pricing
- The constraint violation prices used for PD pricing are informational only and not used for settlement

PD Reports

| Report | New or Existing | Public or Private | Description |
|---|-----------------|-------------------|---|
| Pre-Dispatch Schedules Report | Existing | Private | Hourly energy and operating reserve schedules, issued approximately 30 minutes past each hour. Also indicates whether mitigation was applied and the relevant constrained area condition. |
| Pre-Dispatch Hourly Energy LMP Report | New | Public | LMPs for energy, including LMP components ¹ for all generator and load schedule locations, issued on an hourly basis |
| Pre-Dispatch Hourly Operating Reserve LMP Report | New | Public | LMPs for operating reserve, including LMP components ¹ for all eligible generator and load schedule locations, issued on an hourly basis |
| Real-time Financial Reference Level Values Report | New | Private | Updated reference level values used by the PD and RTM engines based on MP changes to their reference levels, issued as required |
| Daily Energy Limit (DEL) Tracking | New | Private | Actual and scheduled usage of DEL as tracked against MP submitted MaxDEL and MinDEL, issued on an hourly basis |
| Number of Starts Tracking | New | Private | Actual and scheduled number of starts as tracked against MP submitted MNSPD, issued on an hourly basis |
| Generator Output and Capability Report | Existing | Public | Hourly energy output and capability based on outages by generation resource, published on an hourly basis |

¹ For energy LMP, components include loss and congestion prices. For operating reserve LMP, components include congestion price

RTM Engine Initializing Conditions

- MPs submitting revisions to dispatch data for use by the RTM calculation engine should be aware of the following initialization conditions:
 - Daily dispatch data not evaluated by the RTM engine
 - HMR evaluation by the RTM engine
 - MinDEL evaluation by the RTM engine

Daily Dispatch Data not Evaluated by RTM Engine

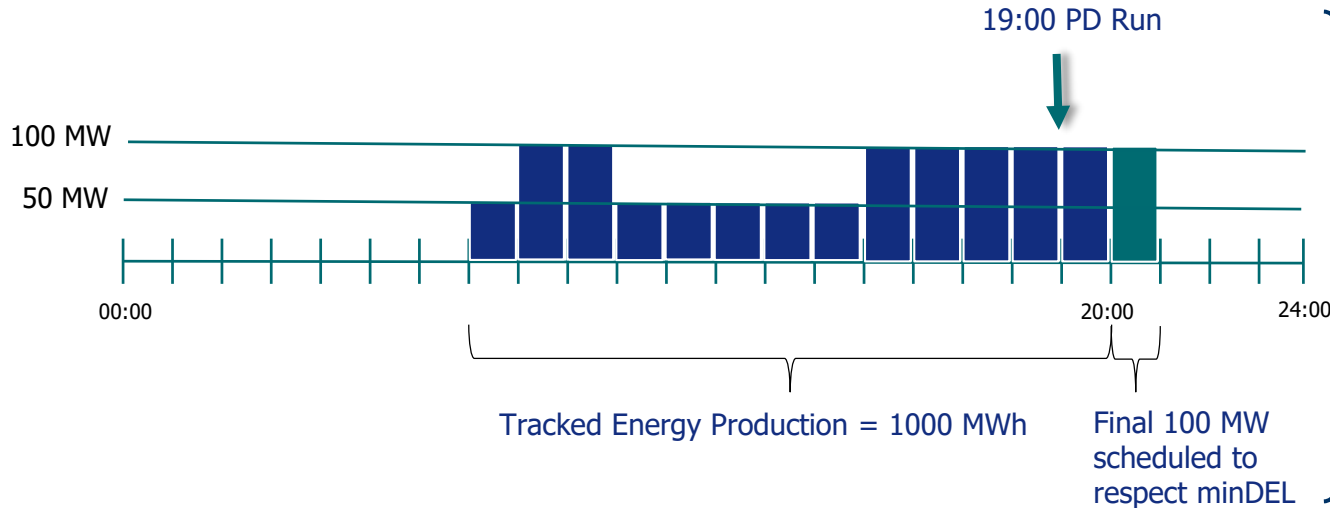
| Dispatch Data Parameter Not Evaluated by RTM Engine | Example of Available MP Actions if the Constraint Associated with the Dispatch Data Parameter is Expected to be Reached |
|---|--|
| MaxDEL | Submit an outage to dispatch a hydroelectric resource to 0 MW when the MaxDEL is expected to be reached during the dispatch hour |
| MNSPD | Submit an outage to inform the RT calculation engine that additional starts are unavailable if the MNSPD for a resource is reached during the dispatch hour |
| MHO | <p>If spill conditions are expected in advance of the dispatch hour:</p> <ul style="list-style-type: none"> • Submit an hourly must run value for that dispatch hour if a must run condition is expected to develop; or • Submit an outage for the duration of that dispatch hour if the resource is unavailable. <p>If spill conditions develop during the dispatch hour:</p> <ul style="list-style-type: none"> • Request that the IESO apply a minimum generation constraint for a must run condition; or • Submit an outage request to dispatch the resource to 0 MW if the resource is unavailable. |
| Linked forebays, time lag and MWh ratio | <p>If an upstream resource generates in real-time and there is no flexibility at downstream resources:</p> <ul style="list-style-type: none"> • Submit an hourly must-run value to reflect must run conditions on downstream resources for future dispatch hours <p>When must run conditions develop within the dispatch hour:</p> <ul style="list-style-type: none"> • Request that the IESO apply a minimum generation constraint to downstream resources |

HMR and MinDEL in the RTM Engine

- HMR is enforced in the RTM by the use of minimum constraints
- MinDEL is only respected by the RTM engine if it is binding in the previous PD engine run

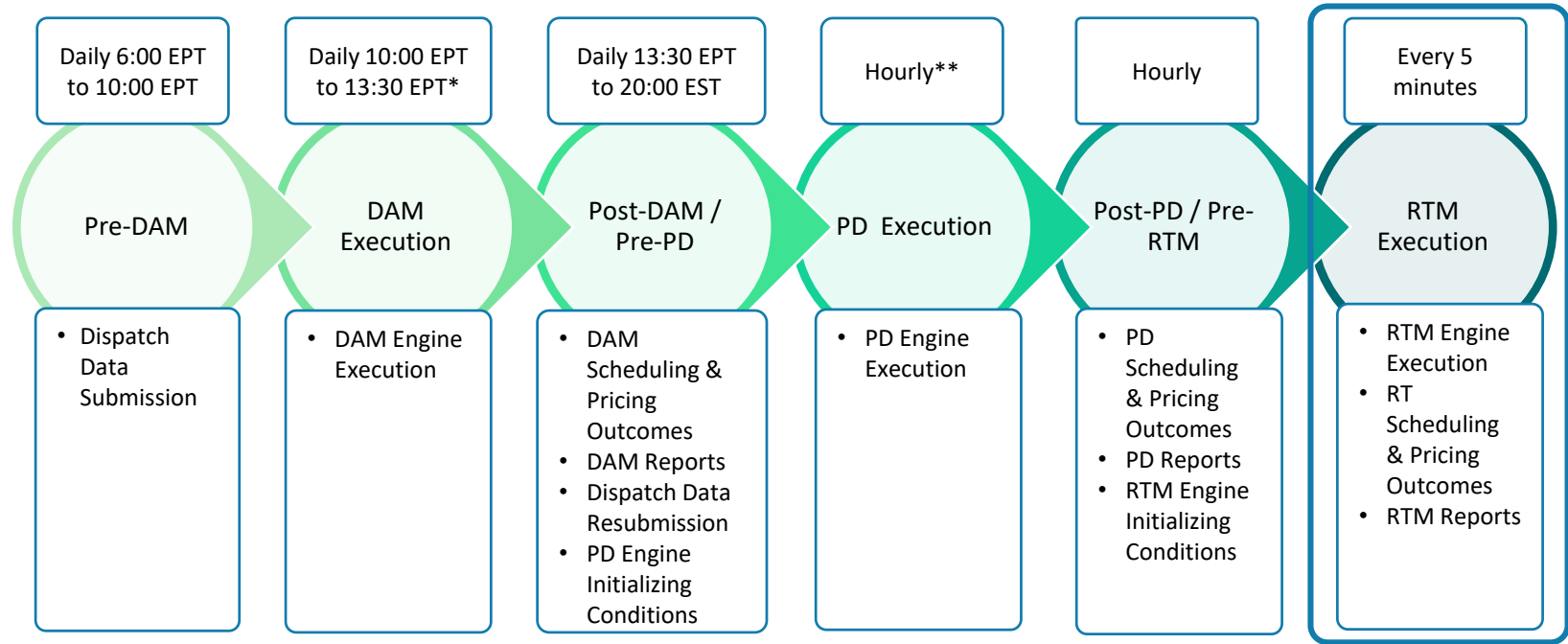
Example: MinDEL Constraint from PD to RT

Scenario: MP submits a MinDEL of 1100 MWh for a resource



A minimum constraint of 100 MW will be created for HE21 from the 19:00 PD run results to respect the MinDEL in RT

RTM Execution

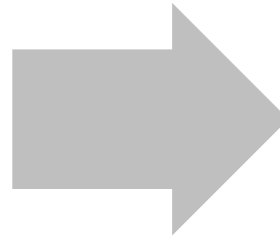


* DAM execution can be extended until 15:30 EPT

** PD execution occurs hourly on rolling basis with first run starting 20:00 EST on the day prior to the dispatch day and the last run starting at 19:00 EST of the dispatch day

RTM Engine Execution Overview

PD Engine Run
1 hour prior to the
RTM dispatch hour



RTM Engine

- Determines hourly schedules and prices to meet composite demand
- Uses ex-ante mitigation decisions accumulated from previous PD runs

- Determines schedules and prices to meet actual demand every 5 minutes, and forecast real-time demand for the next ten 5-minute intervals
- No ex-ante MPM in RTM
- Mitigated energy and operating reserve offers are passed from latest PD run to the RTM engine

RTM Scheduling and Pricing Outcomes

- RTM energy and operating reserve schedules are produced every 5 minutes similar to today (for energy, in the form of dispatch instructions)
- Corresponding LMPs are produced every 5 minutes at each resource location
- Key input factors that may influence differences in scheduling and pricing relative to today's RTM include:
 - Evaluation of new dispatch data constraints passed from PD
 - Ex-ante MPM decisions passed from PD
 - Constraint violation prices
- Actual production and corresponding LMPs are used for settlement

RTM Scheduling and Pricing Outcomes (cont'd)

| RT Interval Schedule | Outcomes | Dispatchable Hydroelectric Resources |
|----------------------|---|--------------------------------------|
| Energy | Dispatch produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation from PD | ✓ |
| | Actual production + LMP used for settlement | ✓ |
| Operating reserve | Schedule produced | ✓ |
| | LMP produced | ✓ |
| | Subject to ex-ante offer mitigation from PD | ✓ |
| | Schedule + LMP used for settlement | ✓ |

RTM Constraint Violation Prices

- The constraint violation prices discussed for DAM and PD scheduling and pricing also apply to RTM scheduling and pricing
- Similar to DAM, the constraint violation prices used for RTM pricing are used for settlement

RTM Reports

| Report | New or Existing | Public or Private | Description |
|---|-----------------|-------------------|--|
| Real-Time 5-min Energy LMP Report | New | Public | LMPs for energy, including LMP components for all generator and load schedule locations, issued every 5 minutes |
| Real-Time 5-min Operating Reserve LMP Report | New | Public | LMPs for operating reserve, including LMP components for all eligible generator and load schedule locations, issued every 5 minutes |
| Real-Time Energy and Operating Reserve Schedule Report | Existing | Private | 5-minute energy and operating reserve schedules, issued every 5 minutes |
| Real-Time Energy and Operating Reserve Dispatch Report | Existing | Private | Summary of dispatch instructions for energy and operating reserve for the previous dispatch hour |
| Dispatch Advisory Report | Existing | Private | Dispatch advisories – consisting of anticipated dispatch instructions – for energy and all classes of operating reserve up to 55 minutes before the relevant dispatch interval |
| Dispatch Data Report for Real Time Scheduling Processes | New | Private | Confirmation of an MP's daily and hourly dispatch data submitted into the RTM, issued daily at 6:00 EST following the dispatch day |

¹ For energy LMP, components include loss and congestion prices. For operating reserve LMP, components include congestion price

Summary of Today's Discussion

- Relevant dispatch data parameters and their applicability within each engine
- Overview of DAM, PD and RTM engine functionality and relevant scheduling and pricing outcomes
- Requirements and considerations specific to dispatchable hydroelectric resources dispatch data submission and resubmission
- Overview of ex-ante MPM applicability for dispatchable hydroelectric resources
- Applicable DAM, PD and RTM reports

Next Steps

- Additional Q&A session for GOG-eligible NQS resources is scheduled on October 3rd
- Should any further clarifications be necessary to support stakeholder's review of the MSO batch, please contact engagement@ieso.ca
- **November 8:** Written stakeholder feedback due on the MSO batch market rules and market manuals can be submitted to engagement@ieso.ca

Thank You

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