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

January 31, 2018

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DISCLAIMER

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Preliminary Decisions

- Stakeholders have asked the IESO to bring forward preliminary decisions where possible.
- These materials identify preliminary decisions and offer supporting rationale.
- The IESO has made preliminary decisions where there is a single 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, are intended to facilitate progress on design elements, and are subject to final decision-making at the High Level Design Phase.

Acronyms

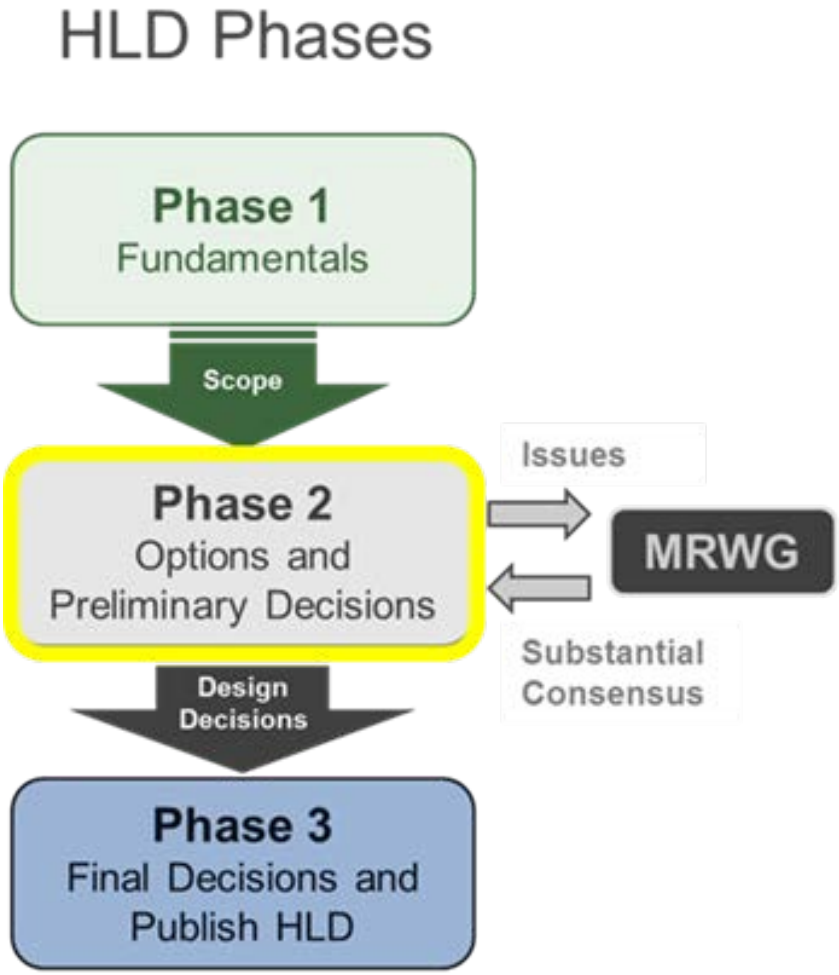
DAM	Day-Ahead Market
ERUC	Enhanced Real-time Unit Commitment
IS	Interchange Scheduling
MGBRT	Minimum Generation Block Run-Time
MGBDT	Minimum Generation Block Down-Time
MLP	Minimum Loading Point
NQS	Non-Quick Start
OR	Operating Reserves
PD	Pre-Dispatch
RT-GCG	Real-Time Generation Cost Guarantee

Agenda

- ERUC Project Recap
- Discussion of Pre-Dispatch Timeframe
- Design Elements
  - Design Element Highlights
  - FTI Observations
  - Status of Design or Preliminary Decision
  - Next Steps or Secondary Design Considerations

High Level Design

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



Recap - ERUC Purpose

- ERUC will be a security constrained unit commitment, jointly optimizing energy and operating reserves over the look-ahead period, in the pre-dispatch timeframe.
  - Replaces the current RT-GCG program
  - Minimizes overall production costs
- ERUC will consider all resource offers to determine optimal mix of resources to meet system requirements

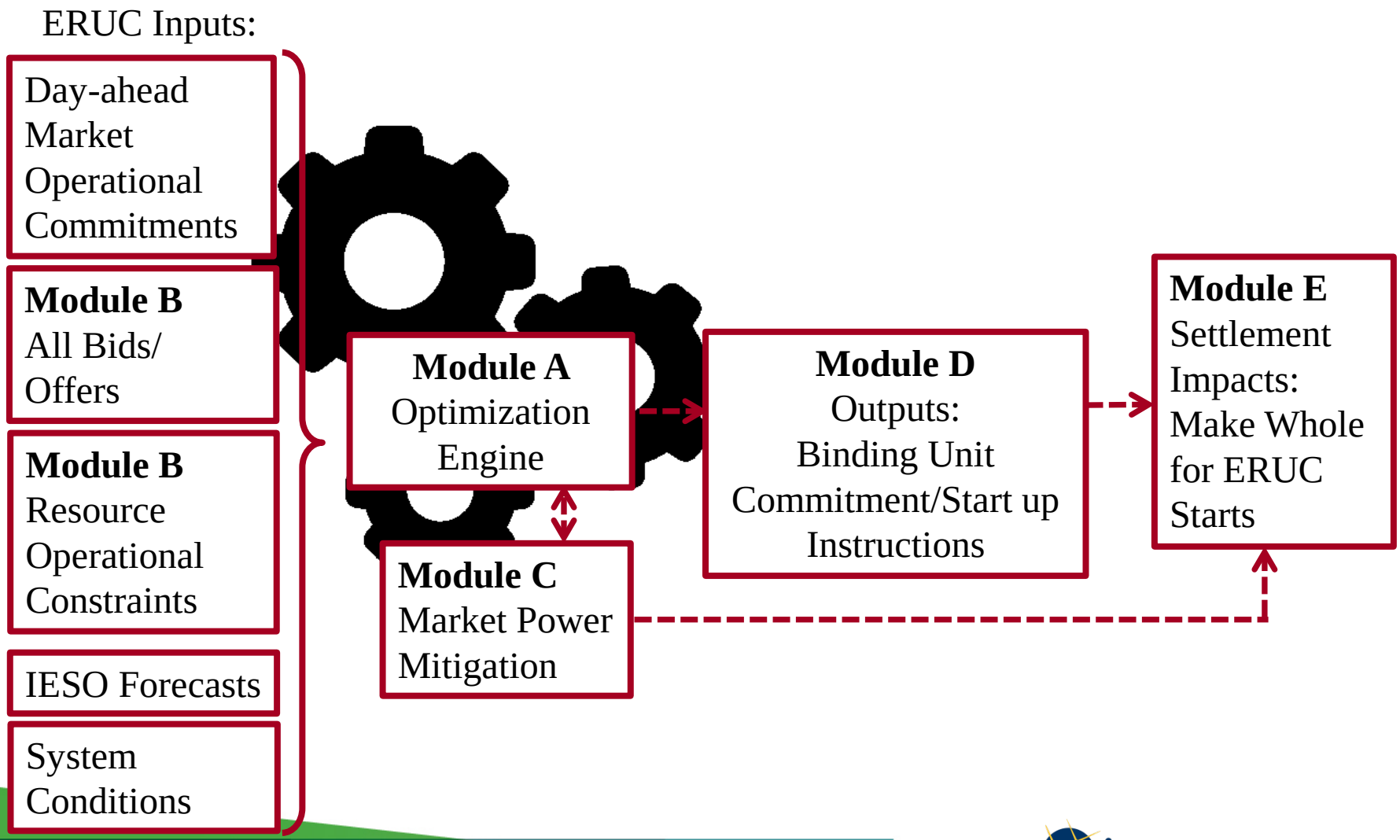
Recap - ERUC Purpose

- An eligible resource will be committed by ERUC if it is the lowest cost resource needed to meet system requirements
- Resources will be eligible for commitment (and make-whole) to the extent that they have registered operational constraints and elapsed time to dispatch >1 hr
- If ERUC does not indicate that commitment is required to meet system requirements, no commitment will be made

Optimization

- ERUC will be different than the current real-time unit commitment in several important ways. ERUC will:
  - Use three-part offers for incremental energy, start-up and speed-no-load costs;
  - Respect resource operational constraints;
  - Conduct an evaluation of unit commitment over the minimum run time of the resource or longer; and
  - Produce binding start-up instructions and operational commitments.

Overview


ERUC Inputs:
Day-ahead Market Operational Commitments
Module B All Bids/ Offers
Module B Resource Operational Constraints
IESO Forecasts
System Conditions
Module A Optimization Engine
Module C Market Power Mitigation
Module D Outputs: Binding Unit Commitment/Start up Instructions
Module E Settlement Impacts: Make Whole for ERUC Starts

Design Elements for Discussion Today

Module	Module Name	#	Design Element	Preliminary Decision?
A	Engine Parameters	1	Functional Passes	Yes
		2	Look-Ahead Period	Status of design
		3	Timing and Frequency of Run	Status of design
		4	Time Step	Yes
B	Participation and Input Data	5	Intertie Transactions	Status of design
		6	Must Offer Requirements	Yes
		7	Eligibility for Make-whole	Yes
		8	Market Participant Data	Yes
C	Market Power Mitigation	9	Commitment Cost Mitigation	Yes
		10	Offer Changes	Yes
D	Output of Engine	11	Binding Start-up Instruction and Operational Constraint	Yes
E	Settlements	12	Calculation of Make-whole Payment	Status of design
		13	Failure Charge	Yes

ERUC'S IMPACT ON PRE-DISPATCH TIMEFRAME

ERUC's Impact on Pre-dispatch

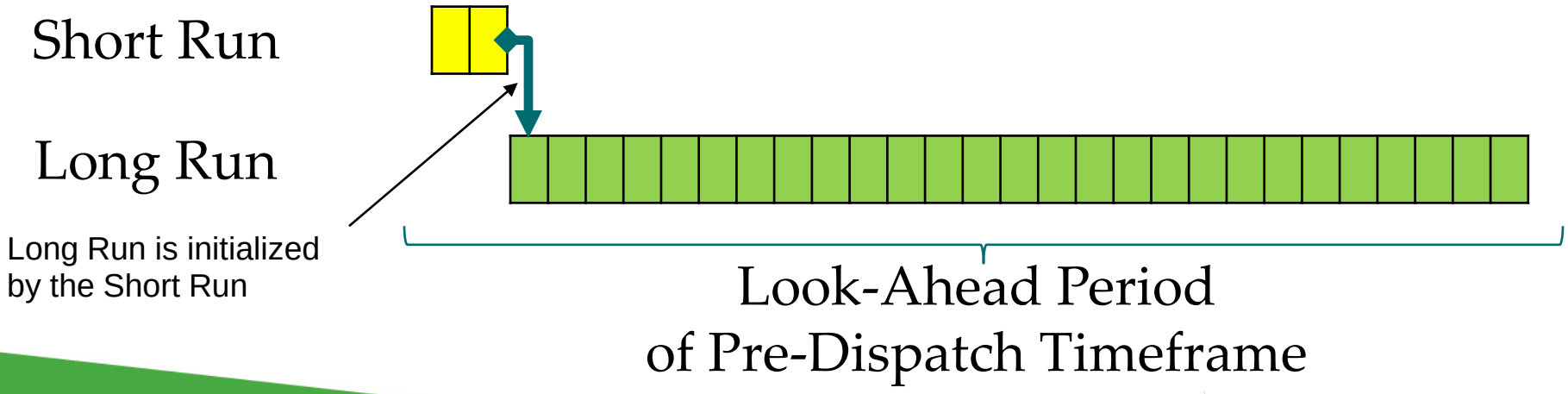
- Today, the pre-dispatch timeframe bridges the DACP to the dispatch hour and serves multiple purposes:
  - RT unit commitment
  - Interchange Scheduling (IS)
  - Publish advisory prices and schedules
- ERUC will implement a unit commitment process that replaces the current RT-GCG program but will take longer to process
- IS needs to accommodate timely checkout with other jurisdictions and therefore may be separate from ERUC

Division of Pre-Dispatch Timeframe

Short Run (IS)
• Focus on near term hours, evaluating offers from NQS resources that are already online, fast start and QS resources, imports/exports • Produce binding interchange scheduling for the next hour • Provide advisory schedules and prices • Results from Short Run are used to initialize the Long Run
Long Run (ERUC)
• Long look-ahead period evaluating all resource types to determine optimal mix of resources to meet system requirements • Produce unit commitments for NQS resources, incorporating any NQS operational constraints from DAM o Evaluates three-part offers o Multi Hour optimization that respects operational parameters • Provide advisory schedules and prices

Sequenced Pre-Dispatch Timeframe

- A full run of Pre-Dispatch would sequentially run the Short Run and then the Long Run
  - Short Run would produce updated interchange schedules with a short look-ahead period for near-term hours
  - Long Run would produce updated unit commitments with a longer look-ahead period
  - Both runs would produce advisory schedules that are subject to RT scheduling



Impact on Design Elements

- In the following slides, the IESO will outline potential options or preliminary decisions for design elements introduced in earlier sessions
- Unless otherwise noted, the same options and decisions apply to both the Long Run (ERUC unit-commitment) and Short Run (interchange scheduling)

DESIGN ELEMENT NO. 1: FUNCTIONAL PASSES

Recap – Functional Passes

- Establishes the number of optimization passes and the function of each of the passes the ERUC software will execute each time a run is completed
- Each pass will jointly optimize energy and all classes of operating reserves to minimize overall production costs
- Need to consider:
  - demand forecast
  - operational constraints from DAM
  - market power mitigation

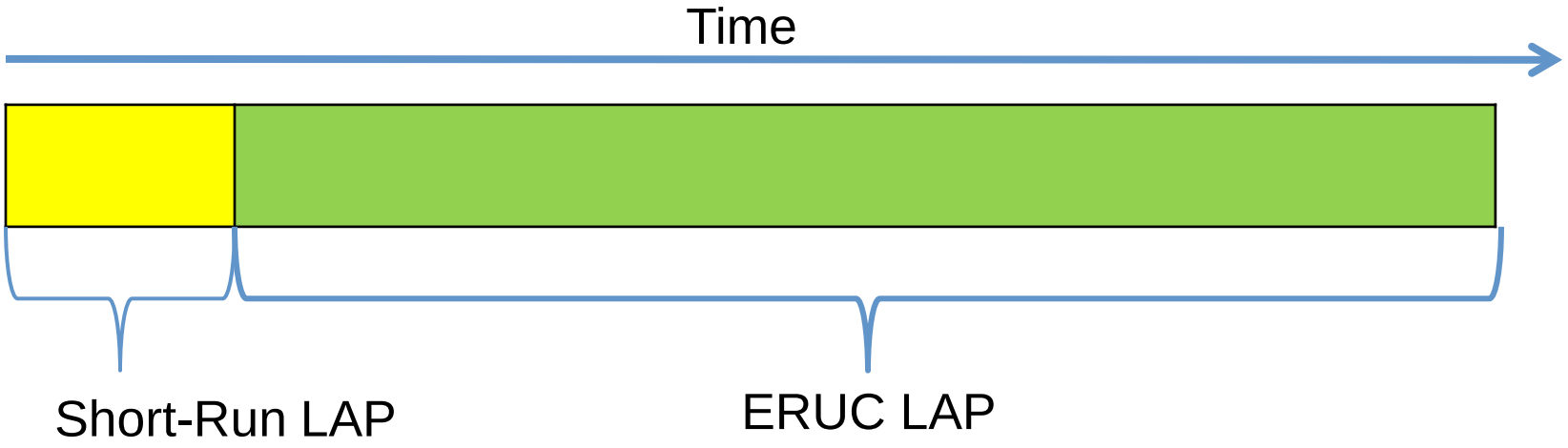
Preliminary Decision

- Functional passes will perform optimization to minimize total production costs based on latest system conditions
- Non-dispatchable load quantity for each hour will be the forecasted hourly peak or forecasted hourly average quantity, consistent with current practice
- DAM operational constraints for resources will be respected
- Market power mitigation will be applied

DESIGN ELEMENT NO. 2: LOOK-AHEAD PERIOD

Recap – Look-Ahead Period (LAP)

- Establishes the timeframe over which the ERUC engine performs the optimization
- The look-ahead period for ERUC will identify the boundaries for the evaluation of resource offers used to make operational unit commitments



FTI Observations

- The determination of the look-ahead period should take into account:
  - The start-up and minimum run times of the units that will be committed by ERUC
  - The ability to include daily energy limits and both the morning and evening peaks in the analysis; and
  - The processing time required for the ERUC run
- The determination of the look-ahead period should balance the benefit of considering impacts over a longer period of time in the economic evaluation versus the solution time impact

Benefits of a Longer LAP

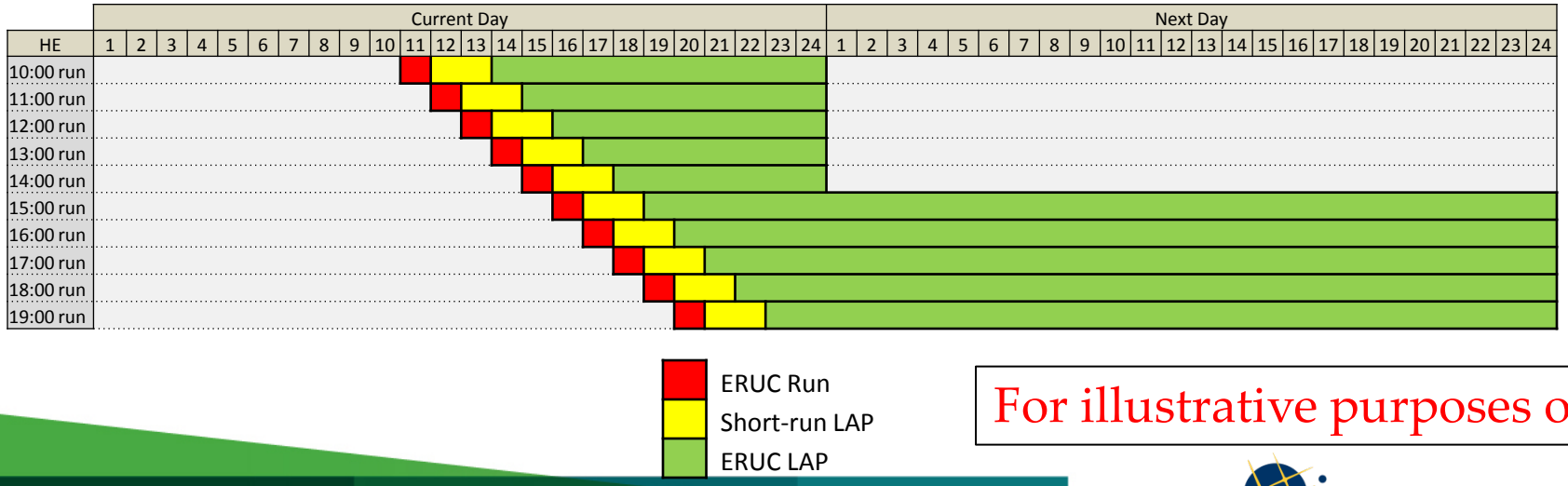
- Allows ERUC to fully consider the majority of NQS units given their start-up and minimum run times
- Allows ERUC to consider days with two peaks in the same optimization
  - Other ISOs are finding they have a need to use a longer look-ahead period considering dual peaks in order to manage decisions to bring start-limited or use-limited resources online or offline
  - Although there is more forecast uncertainty over a longer LAP, the differences between DA and RT are relatively small and the load forecast is updated throughout the day

Benefits of a Longer LAP

- Potentially more efficient commitment decisions
  - A unit with lower energy costs & higher start-up costs may be more expensive relative to another unit when evaluated over 12 hours, but less expensive over 24 hours
  - Energy limited resources can be utilized more efficiently when looking at the entire day because energy limits are determined as a daily value

Status of LAP Design

- IESO is considering an LAP for ERUC that includes all hours for the rest of the operating day, extended to include hours of the next day after DAM clears
- The decision will consider processing time and frequency of run
- Short run for IS: TBD, between 1 and 3 hours



For illustrative purposes only

Next Steps

- The IESO will be approaching software vendors to discuss the requirements for ERUC
- We need to understand the processing time required for multi-hour optimization with three-part offers, respecting operational constraints and including market power mitigation
- This work will inform our decision-making, and a preliminary decision will be determined

DESIGN ELEMENT NO. 3: TIMING AND FREQUENCY OF RUNS

Recap – Timing and Frequency

- Establishes when & how often the ERUC 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

FTI Observations

- ERUC will need to be run at least every 2 hours to enable ERUC to commit NQS resources in a timely manner
  - Committing resources more than an hour or two later than optimal could unduly raise consumer costs and adversely impact reliability
  - Committing resources more than an hour or two earlier than optimal could raise consumer costs (uplift costs) and require curtailment of zero cost resources that would not be necessary with more optimal commitment timing
- Running ERUC more frequently than hourly would have some benefits from more optimal commitment timing in some circumstances but would require a faster solution time or a more complex implementation design

Benefits of Frequent ERUC Runs

- There are efficiency and reliability benefits to re-optimizing hourly or every second hour that would be lost if run frequency was reduced
- There are informational benefits for the IESO and participants of having advisory schedules and prices updated at least bi-hourly

Status of Design

- ERUC Run (Long Run for unit commitment) should occur at least every 2 hours and, if possible, hourly
- The first ERUC run including hours of the next day will occur after the DAM clears
- Interchange Scheduling (Short Run) will occur hourly in order to enable timely interchange checkout
- The ERUC run will be initialized by the IS run and therefore will occur after the IS run
- The exact timing of each run is yet to be determined

Next Steps

- In order to assess the frequency with which the evaluation can occur, the IESO will be approaching software vendors to discuss requirements for the ERUC optimization
- This work will inform our decision-making, and a preliminary decision will be determined
- The timing of the ERUC and IS runs will also be reviewed and discussed with stakeholders in an upcoming meeting

DESIGN ELEMENT NO. 4: TIME STEP

Recap – Time Step

- Establishes the duration of the evaluation interval used for the optimization, and the scheduling granularity used for commitment instructions
- The time step will affect the efficiency and precision with which units are committed
- Need to consider:
  - efficiency of commitment decisions
  - co-ordination with interchange scheduling
  - processing time

FTI Observations

- An hourly ERUC time step is suitable for evaluating the types of NQS units that ERUC would commit
  - A longer time step would introduce too much imprecision in the commitment timing for NQS units
  - Shorter time steps would increase solution time and would not necessarily provide material benefits with the current resource mix
- The time step may need to be reduced to accommodate future enhancements such as more frequent interchange scheduling or a resource mix with more fast starting generating units

Preliminary Decision

- A one hour time step for the optimization and scheduling granularity will be used for unit commitment (Long Run of Pre-Dispatch)
- A time step of 1 hour will be used for the optimization and scheduling granularity for interchange scheduling (Short Run of Pre-Dispatch)
  - the technical feasibility of a shorter time step for IS will be explored

Rationale

- Hourly time steps in the Long Run will result in faster processing time and enable a longer look-ahead period for unit commitment
- Hourly time steps for the Short Run are consistent with current practice; however, shorter time steps that may result in more timely and efficient scheduling for near term hours could be considered

DESIGN ELEMENT NO. 5: INTERTIE TRANSACTIONS

Recap – Intertie Transactions

- Addresses whether ERUC 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
- Need to consider: potential risks and benefits of including non-DAM intertie transactions

FTI Observations

- The relatively long look-ahead period for ERUC compared to the intra-day economic evaluations of other ISOs requires that the ERUC treatment of intertie transactions be carefully considered by the IESO
- Intertie offers and bids evaluated by ERUC should be expected to be available in real-time:
  - System reliability can be compromised if ERUC makes commitment decisions premised on import offers that may not be available to be scheduled in real-time
  - Committing units in ERUC to support export bids that are withdrawn or reduced prior to real-time can increase costs to consumers

FTI Observations

- Any ERUC unit commitment decisions that consider import offers and/or export bids without binding schedules will require additional rules to incent real-time performance

Options For Consideration

1. ERUC will only evaluate intertie offers and bids for transactions up to their DAM scheduled quantity
2. ERUC will evaluate intertie offers and bids for transactions with a DAM schedule, and also evaluate non-DAM scheduled import offers and/or export bids:
   - bid/offer prices and quantities for non-DAM transactions would be fixed once they receive an ERUC 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

Option 1 - Benefits

- ERUC evaluation of intertie offers and bids for transactions with a DAM schedule only (i.e. excluding non-DAM intertie offers/bids) supports:
  - reliability
  - efficiency
  - ease of implementation

Option 1 - Concerns

- Excluding non-DAM imports and/or exports from the ERUC evaluation could result in an efficiency loss

- Excluding non-DAM imports could exacerbate system security concerns in over-supply conditions

Option 2 – Benefits

- Including non-DAM imports and/or exports could improve efficiency and reliability/security of the system
  - This presumes that application of restrictions and penalties will incentivize these transactions to be offered on the same terms in the interchange scheduling process

Option 2 - Concerns

- Including non-DAM imports and/or exports, even with restrictions/penalties to incentivize them to be available in RT, may still negatively impact reliability and efficiency

- Implementation of restrictions and penalties will be more complex and may not add value if this limits the number of non-DAM transactions that are offered

Considerations – Reliability

- We have considered the impact on system reliability if non-DAM intertie transactions are excluded:
  - imports can be scheduled prior to RT to address system needs
  - IESO operator is able to manually remove DAM exports for reliability reasons, if required
  - we already manage system security under over-supply situations

Considerations - Efficiency

- We have considered the impact on efficiency if non-DAM intertie transactions are excluded :
  - introduction of DAM is expected to reduce the amount of interchange offered during the operating day
  - ERUC will adjust advisory schedules for DAM imports and exports based on economics, improving efficiency
  - in the IS runs, resources can be scheduled down if low cost imports are available, and scheduled up if there is export demand
  - even if they were included in ERUC, it is uncertain that non-DAM interties would participate given penalties and restrictions that are necessary to allow them

Next Steps

- The IESO is further considering the benefits and concerns for each option
- We are interested in receiving stakeholder perspectives

DESIGN ELEMENT NO. 6: MUST OFFER REQUIREMENTS

Recap – Must Offer Requirements

- Establishes required rules for participants to submit offers for physical availability in the ERUC timeframe.
- Must offer requirements:
  - mitigate the exercise of market power (i.e. physical withholding) for both energy and operating reserves
  - ensure resources that are relied upon for operational adequacy offer their capacity
  - support efficiency by increasing participation in the pre-dispatch timeframe
- Need to consider: market power mitigation, efficiency, increased certainty of operational security & adequacy

FTI Observations

- Day-Ahead must-offer obligations for resources with resource adequacy obligations are a common feature of U.S. ISOs:
  - Some ISOs also have some form of intra-day must offer obligation for resources with resource adequacy obligations
  - Special rules are used to define obligations for variable generation resources and energy limited resources (and other types of use limited resources)
- Must-offer rules should take into account the need for coordination between power and gas markets so that gas-fired resources have the ability to comply with a must-offer obligation

Preliminary Decision & Rationale

- ERUC will apply must offer obligations in the pre-dispatch timeframe for energy and reserves that are similar to those applied in the DAM
- Rationale:
  - Supports operational certainty and adequacy
  - Prevents physical withholding and ensures the potential exercise of local market power is evaluated in a fair and consistent manner
  - Maximizes the efficiency of scheduling and unit commitment by evaluating bids and offers from all available and capable resources

Other Option

- No must offer obligation
  - Currently, there is no obligation to offer into the pre-dispatch timeframe
  - However the status quo is no longer acceptable due to the need to address the potential exercise of local market power in the form of physical withholding
  - Physical withholding in constrained areas can result in efficiency losses and increased costs for load
  - Operational certainty and system adequacy can also be negatively impacted

Secondary Design Considerations

- What is the process for the resource to indicate it is not available i.e. outage notification, such that it may be exempt from must offer while unavailable?
- What is the process to determine capacity for all resource types for the ERUC must offer obligation?
- What are the consequences of not meeting obligations?

DESIGN ELEMENT NO. 7: ELIGIBILITY FOR MAKE WHOLE PAYMENT

Recap – Eligibility for Make Whole Payment

- Establishes the physical characteristics that a resource must have in order to receive a binding commitment from ERUC and to be eligible for real-time make whole payments for these commitments
- Resources need to understand if they are eligible in order to appropriately offer supply into the market using three part offers

Preliminary Decision & Rationale

- The same resource characteristics establishing eligibility for current RT and DA guarantees will be used to determine eligibility for commitment and make-whole under ERUC (operational constraints e.g. MLP, MGBRT, elapsed time to dispatch > 1 hour)
- Rationale:
  - The purpose of ERUC is to replace the RT-GCG program with a more efficient unit commitment while ensuring that system reliability is maintained

DESIGN ELEMENT NO. 8: MARKET PARTICIPANT DATA

Recap – Market Participant Data

- Establishes the data necessary for ERUC to economically evaluate unit commitment of resources eligible for make-whole payments
- ERUC will consider three-part offers (energy, speed-no-load and start-up costs) and operating parameters
- This data will allow ERUC to optimize a security-constrained economic unit commitment and determine the most efficient commitments considering all resources, and respecting operational constraints
- Need to consider: new data required by ERUC in order to efficiently commit generators

FTI Observations

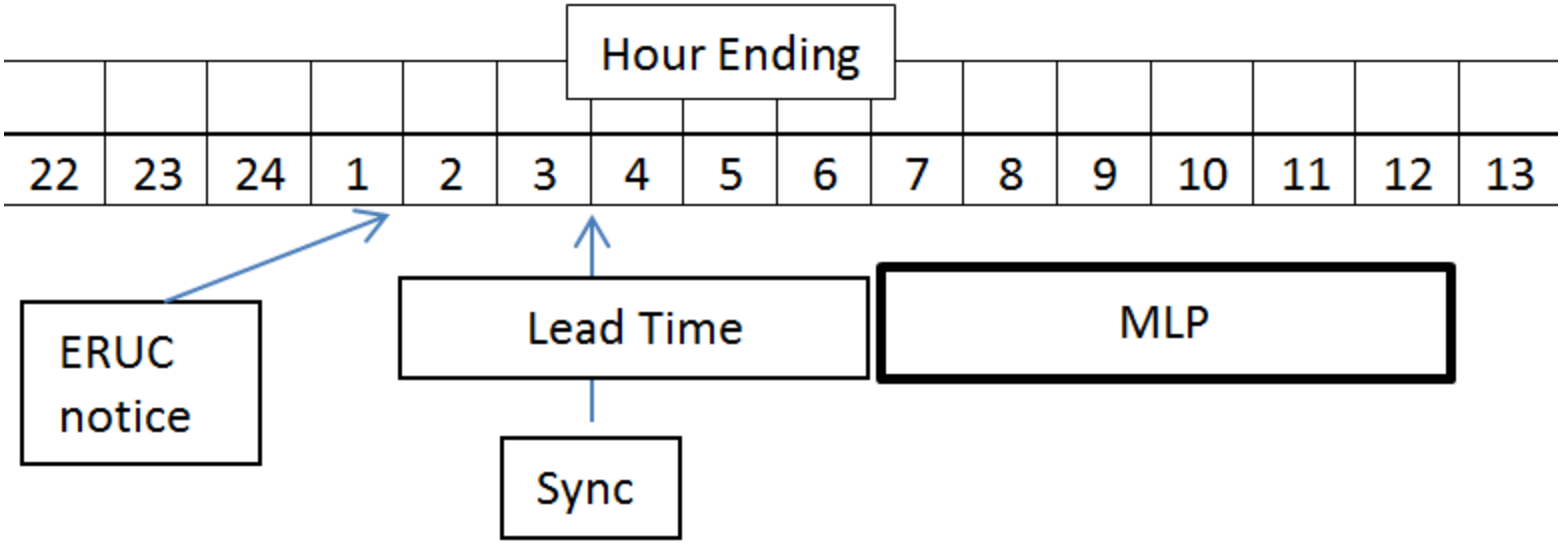
- Under its current DACP, the IESO requires NQS generators to provide most of the operating parameters necessary for the ERUC analysis
- In addition, ERUC will now need to also know the length of time necessary for a resource to start-up and reach its minimum loading point (lead time) in order to accurately evaluate unit commitment
- U.S. ISOs require the submission of cold, warm and hot start-up times for generation resources

Lead Time

- Lead time is the amount of notice a generator needs in order to reach MLP from being offline, including the start-up process, synchronization and ramp to MLP
- Lead time varies depending on how long the generator has been offline (cold, warm, hot); a unit that has been offline for a longer period may have a longer lead time
- Submission of lead time is necessary for the ERUC optimization

Lead Time

Example: A generator submits lead time of 5 hours along with three-part offers. The ERUC run completed at 01:00 correctly evaluates the unit starting at HE7 because this is the first hour it is capable of reaching MLP.



Preliminary Decision & Rationale

- Generators will provide:
  - three-part offers – energy, speed-no-load and start-up costs
  - operational data
    - ✓ New – lead time
    - ✓ Current – MGBRT, MGBDT, MLP, max. # of starts per day and ramp rates
- Rationale:
  - Need three-part offers in order to optimize based on complete cost information
  - Need operational data in order to optimize while respecting operational constraints, and to produce timely binding start-up instructions

Operational Data

- Operational data such as MGBRT, MGBDT, MLP, max. # of starts per day and ramp rates must be registered with the IESO during the market registration process
- Operational data may also be provided as offered data; for example, in DACP, generators provide daily generator data which can be updated daily depending on conditions
- When operational data is offered into the market in this manner, it is called "non-price offer parameter" data

Secondary Design Considerations

- Will operational data be provided as registered data only, or also as non-price offer parameter data?

DESIGN ELEMENT NO. 9: COMMITMENT COST MITIGATION

Background - Market Power Mitigation

- Market Power Mitigation (MPM) design includes tests of market power which may trigger the application of mitigation; this mitigation will be applied in DAM, ERUC as well as in real-time
- The conduct and impact market power test requires the determination of reference levels for incremental energy costs, commitment costs and non-price offer parameters

Recap – Commitment Cost Mitigation

- The Energy work stream will determine the principles to establish reference levels and conduct thresholds for commitment cost offers (start-up, speed-no-load and the energy offer up to MLP) and non-price offer parameters
- Reference levels will be applied in DAM and ERUC to restrict the exercise of local market power that could increase costs
- This will increase the efficiency of DAM schedules and ERUC commitments by committing the resources that will be able to meet load at least overall cost

FTI Observations

- Application of market power mitigation to commitment decisions is necessary in order to preclude the exercise of locational market power
- Use of a conduct and impact test will allow the IESO to permit offer price flexibility for resources lacking material market power
- A conduct and impact test is well suited to evaluating the impact of commitment cost offers and non-price parameters on
  - energy and operating reserve market prices; and
  - uplift costs

Background: Reference Levels

- Reference levels for incremental energy costs are generally set in other jurisdictions by one of a number of approaches: offer-based, LMP-based or cost-based
- Reference levels for commitment costs and non-price offer parameters could be based on cost-based estimates and registered values

Reference levels for Price-based Offers

- Two common decision rules for determining which reference price to use are:
  A. fixed hierarchy e.g. offer-based, LMP-based, cost-based, with the first available* option used; or
  B. market participant ranks the options, and the first available* option is used

* based on data availability

Reference Levels for Non-Price Offer Parameters

- Non-price offer parameters are resource physical operational constraints that affect resource commitment and dispatch
- This may include: lead time, MGBRT, MGBDT, MLP, ramp rates over MLP and max # of starts per day
- Reference levels need to be determined for all non-price offer parameters
- The reference level can be based on resource performance specifications, historical operating capability and/or the average reference level for similar units

INFORMATION ON CONDUCT THRESHOLDS (SSM SESSION DECEMBER 11/17)

Conduct Thresholds

There are two general approaches to determining conduct thresholds:

1. Percentage or fixed $/MWh increase over reference (used by New England and SPP)
2. Formulaic approach that depends on prices or estimated costs and the frequency that regions were constrained in a prior period (used by New York and MISO)

Conduct Thresholds – Affected by Competition

- ISOs base the conduct thresholds that they apply on the extent to which competition is restricted.
  - If competition is relatively unrestricted, the most permissive thresholds are applied
  - If competition is routinely hampered by congestion, then less permissive thresholds are applied
  - If competition is severely hampered as a result of a system or local reliability need, the tightest thresholds are applied

Conduct Thresholds – Broad and Narrow Constrained Areas

- In general, ISOs have a set of conduct and impact thresholds for each of: areas that relatively unconstrained ("Broad Constrained Areas"), areas that are frequently constrained ("Narrow Constrained Areas") and for local or system reliability needs.
- This approach is consistent with the current IESO regime which allows for the designation of Constrained-off Watch Zones

Conduct Thresholds – Broad and Narrow Constrained Areas

- The following slides communicate simplified summaries of the detailed methodologies which are found in the tariffs of each of the ISOs. They do not communicate a complete representation of these methodologies
- In general, US ISOs identify a binding transmission constraint in order to apply ex-ante mitigation

Approach 1: ISO-NE & SPP

Broad Constrained Area Conduct Thresholds		
	ISO-NE (requires test for pivotality)	SPP (binding constraint and shift factor of 5% required)
Energy/Minimum Load	lesser of 300% increase or an increase of $100/MWh (excluding bids < $25/MW)	25% (over reference), offers under $25 exempt
Start-up Costs	200% increase (relative to reference)	25% (over reference)
OR/Regulation		25% (over reference), offers under $10/MWh exempt
Time-based Parameters (e.g. MGBRT)	1 parameter: 2 hours increase > 1 parameter: total of 6 hours increase	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease	Minimums: 100% increase Maximums: 50% decrease

Narrow Constrained Area Conduct Thresholds		
	ISO-NE	SPP
Energy/Minimum Load	Lesser of 50% or $25/MWh increase (over reference)	Frequently Constrained: 17.5% (over reference), offers under $25 exempt
Start-Up Cost	25% increase (combined with min load cost over reference)	25% (over reference)
OR/Regulation		25% (over reference), offers under $10/MWh exempt
Time-based Parameters (e.g. MGBRT)	1 parameter: 2 hours increase > 1 parameter: total of 6 hours increase	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease	Minimums: 100% increase Maximums: 50% decrease

Local or System Reliability Conduct Thresholds		
	ISO-NE	SPP
Energy/Minimum Load	10% increase (over reference)	10% (over reference), offers under $25 exempt
Start-up Costs	10% increase (over reference)	10% increase (over reference)
OR/Regulation		10% (over reference), offers under $10/MWh exempt
Minimum run time, down-time and start-up time	1 parameter: 2 hours increase > 1 parameter: total of 6 hours increase	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease	Minimums: 100% increase Maximums: 50% decrease

Approach 2: MISO & NYISO

Broad Constrained Area Conduct Thresholds		
	NYISO (ex-post as per FERC requirement)	MISO (requires binding transmission constraint and shift factor)
Energy/Minimum Load	lesser of 300% increase or an increase of $100/MWh (excluding bids < $25/MW)	lesser of 300% increase or an increase of $100/MWh (excluding bids < $25/MW)
Start-Up Costs	50% increase (over reference)	200% (over reference)
OR/Regulation	lesser of 300% increase or an increase of $50 per megawatt (excluding bids < $5/MW)	lesser of 300% increase or an increase of $50 per megawatt (excluding 30m OR bids < $5/MW and 10m OR/regulation bids <$10)
Time-based Parameters (e.g. MGBRT)	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease	Minimums: 100% increase Maximums: 50% decrease

Narrow Constrained Area Conduct Thresholds	
	NYISO
Energy/Minimum Load	(2% * Average price *8760)/constrained hours • Average price is fuel price-adjusted price over the previous 12 months when a constraint into the area is binding. • Constrained hours is the number of hours in the previous year when an interface into the area was binding.
Start-Up Costs	50% increase (over reference)
OR/Regulation	lesser of 300% increase or an increase of $50 per megawatt (excluding bids < $5/MW)
Time-based Parameters (e.g. MGBRT)	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease

Narrow Constrained Area Conduct Thresholds	
	MISO
Energy/Minimum Load	(Net CONE)/(max: # of constrained hours, 2000) MISO also has dynamic constrained areas that are defined for persistent outages or constraints. For these dynamic constrained areas the conduct threshold is $25/MWh.
Start-Up Costs	50% increase (over reference)
OR/Regulation	lesser of 300% increase or an increase of $50 per megawatt (excluding bids < $5/MW)
Time-based Parameters (e.g. MGBRT)	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Non-price/non-time Parameters (e.g. MLP)	Minimums: 100% increase Maximums: 50% decrease

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Local or System Reliability Conduct Thresholds		
	NYISO	MISO
Energy/Minimum Load	10% or $10/MWh increase	10% in overall production cost for energy, minimum load, start-up and reserves 25% increase in economic minimum limit
Start-Up Costs	10% increase	See above
OR/Regulation	lesser of 300% increase or an increase of $50 per megawatt (excluding bids < $5/MW)	See above
Minimum run time, down-time and start-up time	1 hour increase in aggregate	1 parameter: 3 hours increase > 1 parameter: total of 6 hours increase
Number of stops per day	Decrease by 1 stop or to 1 stop	Minimums: 100% increase Maximums: 50% decrease

Preliminary Decision & Rationale

- We will use short run marginal cost principles (i.e. the cost to produce the next MW of electricity) to develop reference levels for commitment costs including fuel, variable O&M, opportunity costs and other appropriate costs
- We will use accepted principles for establishing reference levels for non-price offer parameters

Secondary Design Considerations

- What specific methodologies will be used for determining reference levels for commitment costs and non-price offer parameters?
- What specific methodologies will be used for determining conduct thresholds for commitment costs and non-price offer parameters?

DESIGN ELEMENT NO. 10: OFFER CHANGES

Recap – Offer Changes

- During the period after the DAM clears until real-time dispatch, ERUC SE will establish where restrictions apply for increases in commitment cost offers, incremental energy offers and OR offers, as well as restrictions on changes to non-price offer parameters
- Restrictions must be applied to offer changes when a generator has a DAM schedule or an ERUC commitment because they have market power
- By applying appropriate restrictions, increases in uplift costs will be limited and efficiency will be improved
- Need to consider: market power, reliability, uplifts and efficiency

FTI Observations

- Restrictions on changes to offers and non-price offer parameters following receipt of an IESO commitment are necessary to ensure the system can be operated reliably and to prevent the exercise of market power
- When establishing restrictions on offer price changes it is important to preserve resource offer price flexibility to the extent it does not permit the exercise of locational market power or incent inefficient bidding strategies
- Rules that restrict changes to offers and non-price resource parameters following receipt of a commitment instruction are standard components of U.S. ISO market power mitigation designs that allow offer price flexibility

Preliminary Decision 1 & Rationale

- No offer price increases allowed for the hours that a resource is committed by ERUC
- The offer prices refer to both energy and OR offer prices, which also include three-part energy offers (energy, speed-no-load and start-up costs)
- Rationale: Balances the need to address potential uplift impacts, exercise of market power, and inefficient resource commitment while avoiding overly restrictive rules.

Preliminary Decision 2 & Rationale

- No changes that make non-price offer parameters more restrictive will be allowed for a resource after its commitment in ERUC
- Rationale: These changes can undermine reliability and increase uplifts

Preliminary Decision 3 & Rationale

- 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: These changes can undermine reliability and increase uplifts

*Note that increases to incremental energy offer prices are allowed after a resource receives a DAM schedule because that schedule is financially binding, providing appropriate incentives for resource participation in real-time market

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?

DESIGN ELEMENT NO. 11: BINDING START-UP INSTRUCTION AND OPERATIONAL CONSTRAINT

Recap – Binding Start-up Instruction and Operational Constraint

- ERUC will issue a binding start-up instruction and apply an operational constraint when the economic evaluation determines a resource is the optimal choice
- An operational constraint ensures that operating parameters of the resource are respected
- This ERUC output supports efficient resource commitment and operational certainty
- Need to consider: frequency of run, impact of over-commitment, when the commitment takes place

FTI Observations

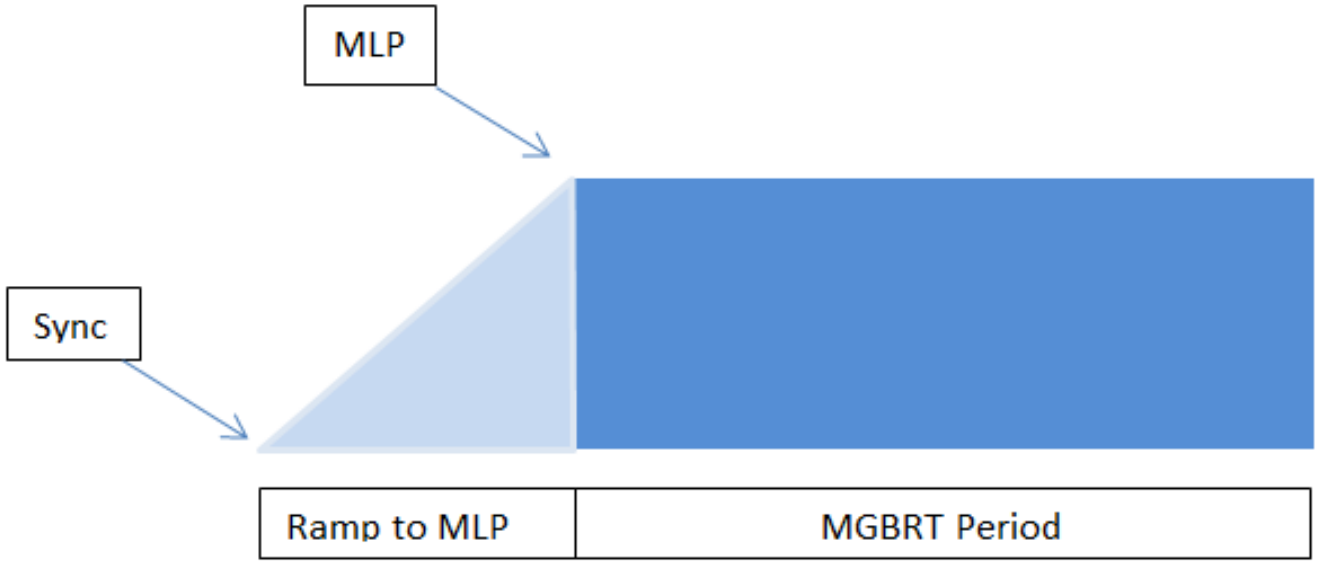
- Commitment of a resource for its minimum generation block run time is compliant with resource operational constraints and provides ERUC the flexibility to re-evaluate continued resource commitment at a later point in time

Preliminary Decision & Rationale

- The initial operational constraint will be for the MGBRT period; operational constraint beyond MGBRT will occur as determined by regular ERUC runs
- Commitment is confirmed in the last ERUC run that allows for the resource's required lead time
- Rationale:
  - MGBRT operational constraint is adequate to bring the lowest cost resource online
  - Extended operational constraints can occur on an hourly or bi-hourly basis, as required
  - Need to limit over-commitment due to changes in system needs over the day

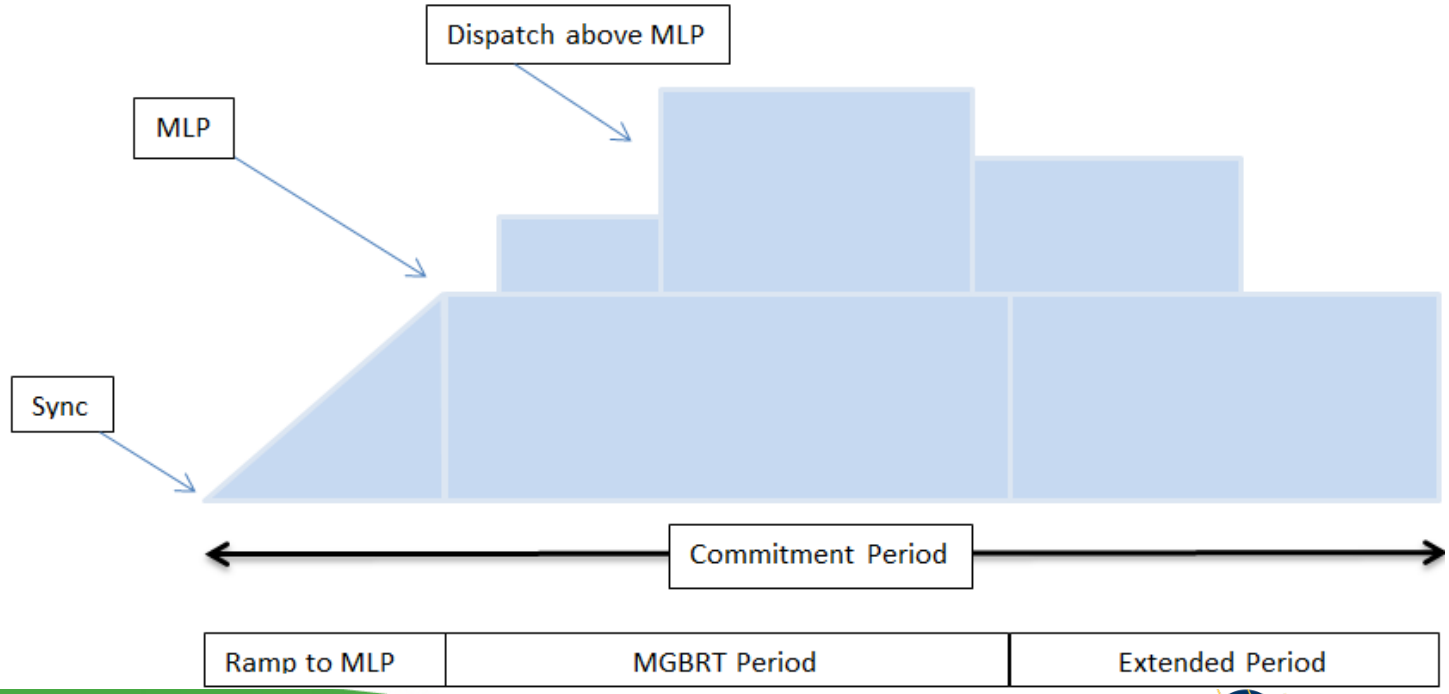
Initial Operational Constraint

- When the ERUC evaluation determines that a resource is the optimal choice, it will issue a binding start-up instruction and apply an initial operational constraint at MLP for the MGBRT period:



Commitment Period

- The operational constraint may be extended by regular ERUC runs; the commitment period will be the entire period of time that the generator is constrained at MLP, which may or may not extend beyond MGBRT



Other Option

- ERUC could provide an initial operational constraint equal to the longer of the MGBRT and the period the resource is evaluated as economic
  - This option is not preferred because over-commitment will occur if system needs decrease over the day, and a longer initial operational constraint is unnecessary to bring the resource online
  - Regular ERUC runs can extend the MGBRT constraint based on up-to-date information

Secondary Design Considerations

- What flexibility will ERUC have in changing the operational constraints for NQS units with a DAM schedule (e.g. shift the MGBRT forward, delay the MGBRT, add hours beyond a fixed MGBRT)?

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

Recap – Calculation of Make-whole Payment

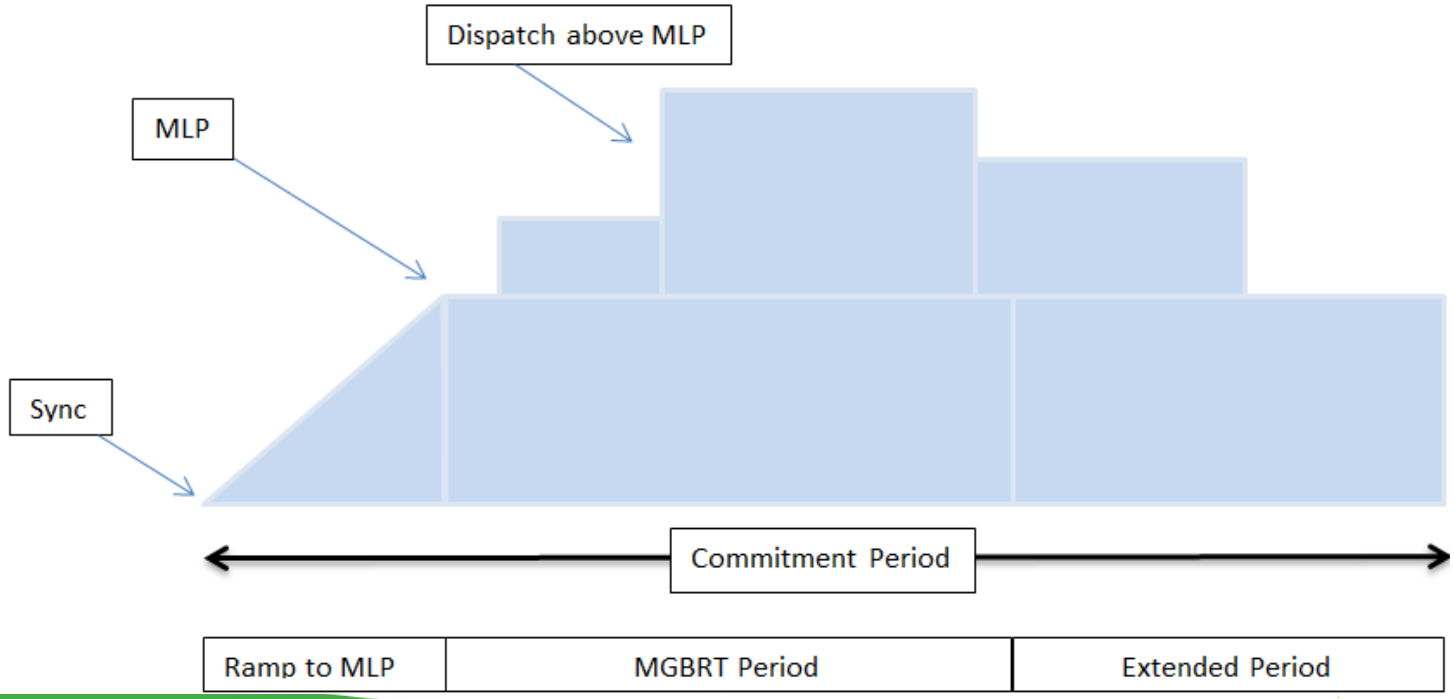
- An eligible generator's real-time revenues should be sufficient to recover their as-offered costs (subject to mitigation)
- The make-whole payment is intended to provide the correct incentives for generators to come online when needed to meet system requirements
- Need to consider: costs/revenues and timeframe over which to calculate make-whole

FTI Observations

- The calculation of make-whole payments typically takes into account all revenues and costs associated with the resource's commitment
- The eligibility for make-whole payments depends on the specific circumstances of a resource commitment:
  - Resources committed by IESO economically or for reliability should be eligible for make-whole payment
  - Resources should not be eligible for make-whole payments during periods when they are self-committed or are ramp constrained up or down because of changes in prior offers
- The design and calculation of make-whole payments should not incentivize market participants to use offer strategies that inflate make-whole payments

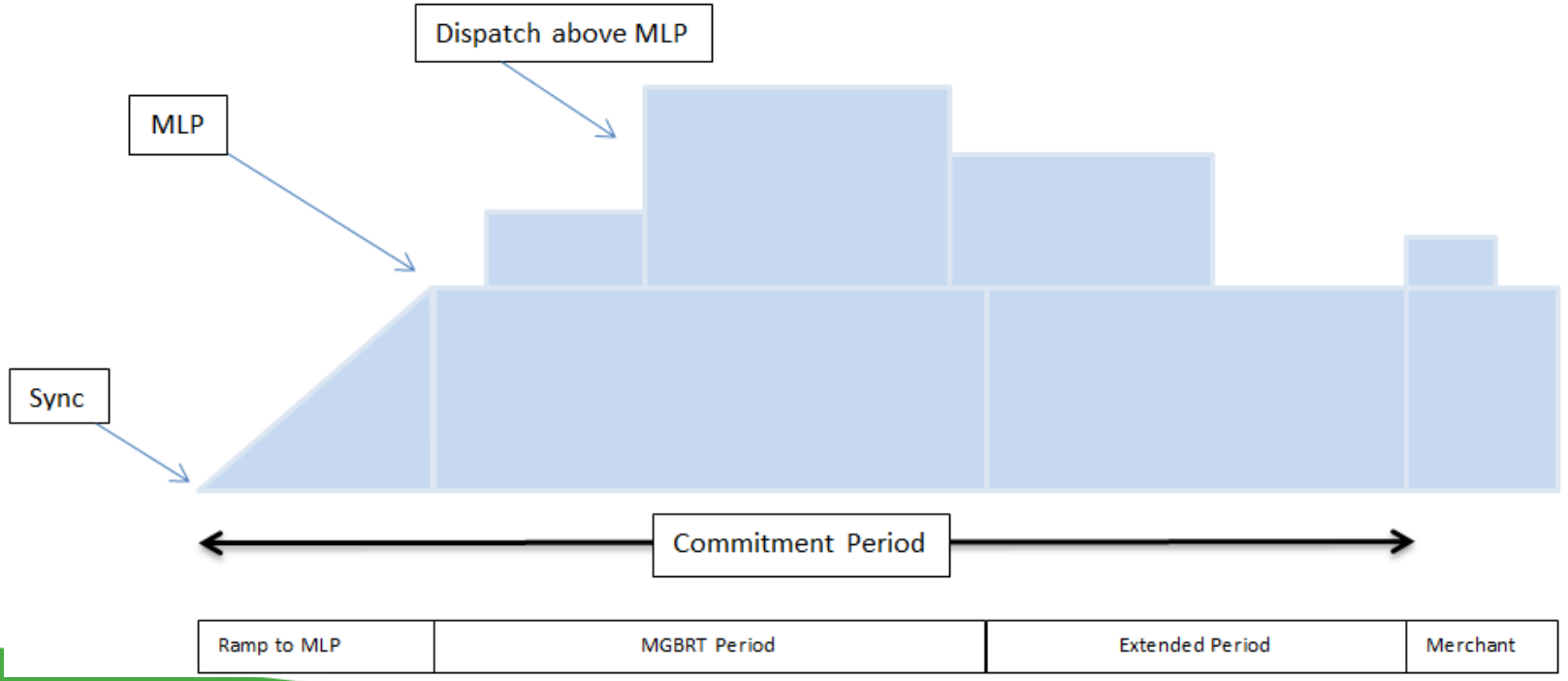
Option 1

- Make-whole payment could include all energy and OR revenues, net of all as-offered commitment costs, incremental energy costs (over MLP) and OR costs over the commitment period



Option 2

- Make-whole payment could include all energy and OR revenues, net of all as-offered commitment costs, incremental energy costs (over MLP) and OR costs over the operating period of the resource



Commitment Period vs Operating Period

- It is possible that the generator may continue to be dispatched economically after the ERUC commitment period
- The final ERUC commitment run for the dispatch hour will occur several hours before RT, and over this time system conditions may change (e.g. reduced variable generation)
- This may result in the generator receiving an economic dispatch for hours in the short-run (IS) timeframe, not initially required at the time of the ERUC commitment

Considerations

- Generally, the make-whole calculation must provide the correct incentives for generators to come online when required by the system
- It is appropriate to include all relevant costs and revenues that were considered by the optimization in the make-whole calculation
- The generator should be able to retain any net revenues above the as-offered costs evaluated by the optimization in order to provide the correct incentives to operate

Next Steps

- The IESO will consider stakeholder feedback and will provide a preliminary decision at the next meeting

DESIGN ELEMENT NO. 13: FAILURE CHARGE

Recap – Failure Charge

- A financial charge if a NQS generator fails to meet its ERUC commitment in RT
- Failure charges seek to ensure reliability, efficiency and reduce uplifts by incentivizing generators to uphold their ERUC commitment
- Need to consider: impact on reliability, efficiency, RT prices and uplifts

FTI Observations

- Failure charges will provide additional incentives for resources committed in ERUC to perform in real-time
- In U.S. ISOs, resources are typically assessed failure charges through reductions in capacity payments that are in essence penalties for non-performance
- In the absence of a failure charge:
  - Resources committed in ERUC but not in the DAM would not have any binding financial obligation if they did not perform; and,
  - There may be less incentive for the resource to perform in the real-time market even if the resource is required for resource adequacy

Preliminary Decision & Rationale

- 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
- Rationale:
  - There are impacts on reliability, efficiency and cost if a resource is offered in ERUC but is not available to operate in RT
  - With must-offer obligations in the market, resources that are allowed to be committed and withdraw without penalties would effectively be allowed to physically withhold

Other Options

- No failure charge
  - This option is not preferred because generators may have reduced incentive to perform in certain circumstances, and this may impact reliability, efficiency, RT prices and uplifts

- Compliance investigation triggered for failure to meet commitment
  - This option is not preferred because it is administratively burdensome and will not provide timely incentive to perform

Secondary Design Considerations

- What is adequate notice of inability to meet a commitment?
- What are acceptable reasons for failure to meet commitment?
- What financial implications would trigger a failure charge upon failure to meet commitment?

NEXT STEPS

Next Steps

- Please provide feedback by February 15
- The IESO will summarize and respond to all feedback by end of February
- At the next session on March 28, we will:
  - review/discuss stakeholder feedback and IESO responses;
  - provide preliminary decisions for outstanding design elements;
  - confirm preliminary decisions advanced at this meeting, where appropriate; and
  - begin discussing secondary design considerations