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

October 30, 2017

ERUC Stakeholder Engagement

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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 load.
- A non-quick start (NQS) generator will be committed by ERUC if it is the lowest cost resource needed to meet system requirements.

Optimization

- ERUC will be different than the current real-time unit commitment in several important ways. It will:
  - Use three-part offers for incremental energy, start-up and speed-no-load costs;
  - Consider 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.

Recap – Other Jurisdictions

ERUC will differ from post DAM unit commitment engines used by other jurisdictions, which:

1. rely on load serving entities and virtual buyers to submit demand bids in the DAM; and
2. typically have a much larger number of fast start gas-fired resources.

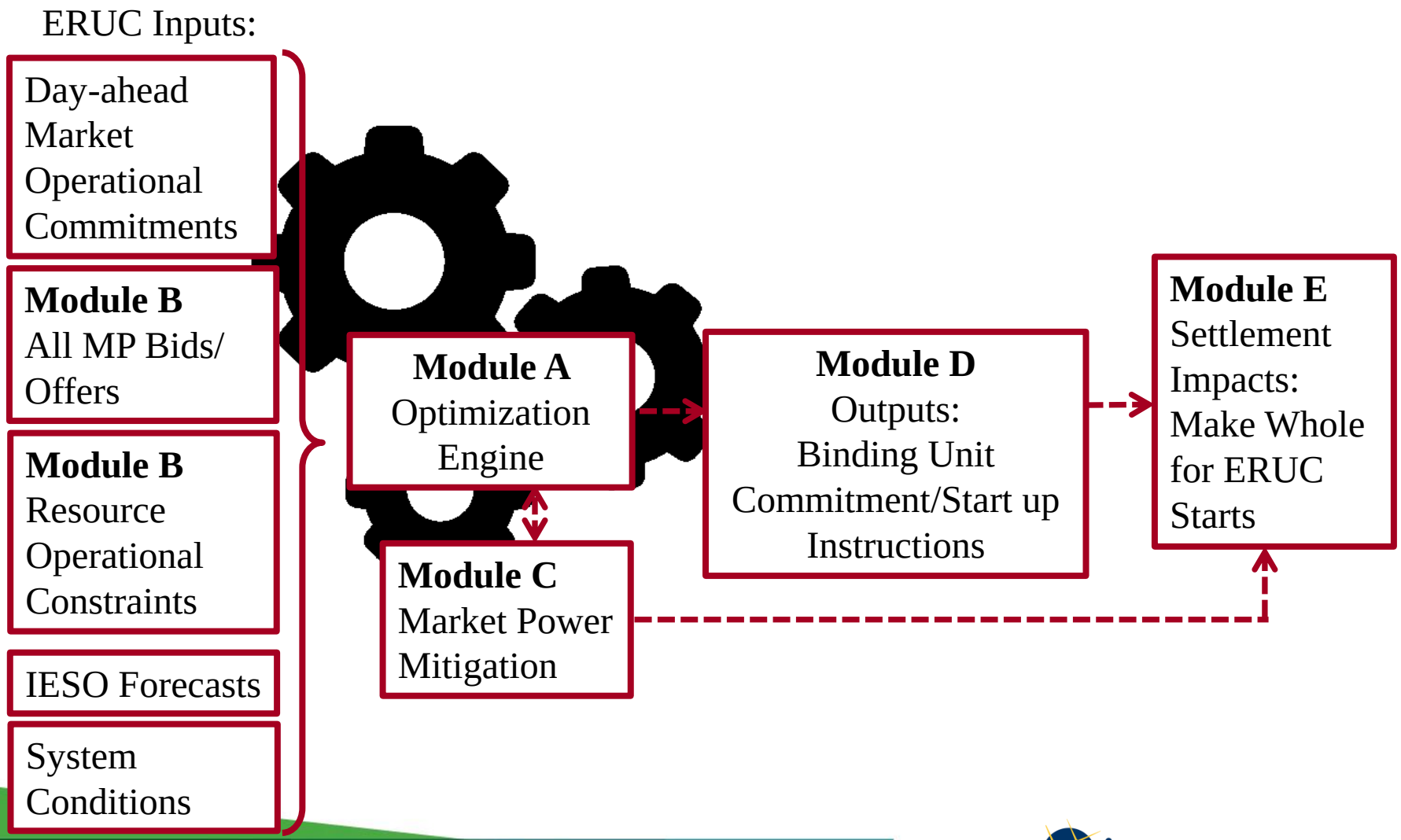
Due to these differences, we will not review in detail how other jurisdictions address each design element.

Recap – ERUC Overview

ERUC will have a look-ahead period longer than other jurisdictions in order to:

1. Allow economic evaluations for commitment decisions throughout the operating day based on IESO net load forecasts; and
2. Address the characteristics of the current Ontario generation resource mix:
   - Large proportion of generators with start times of 2 hours or longer; and
   - Growing supply of variable generation where the IESO must be prepared to balance output variations over the operating day.

Overview


ERUC Inputs:
Day-ahead Market Operational Commitments
Module B All MP 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

Proposed ERUC Design Elements

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

ERUC: Fundamentals

Design Elements 1 – 8

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Toronto, Ontario

FTI

Enhanced Real-time Unit Commitment (ERUC) Modules and Elements for Discussion

Module	Module Name	#	Design Element
A	Engine Parameters	1	Functional Passes
		2	Look-ahead Period
		3	Timing and Frequency of Run
		4	Time Step
B	Participation and Input Data	5	Intertie Transactions
		6	Must Offer Requirements
		7	Eligibility for Commitment
		8	Market Participant Data

Acronyms

DAM	Day-Ahead Market
ERUC	Enhanced Real-time Unit Commitment
MFIS	More Frequent Intertie Scheduling
MGBRT	Minimum Generation Block Run-Time
MGBDT	Minimum Generation Block Down-Time
MLP	Minimum Loading Point
MP	Market Participant
NQS	Non-Quick Start
RT	Real-Time
RT-GCG	Real-Time Generation Cost Guarantee program

DESIGN ELEMENT NO. 1: FUNCTIONAL PASSES

Description – Functional Passes

- Establishes the number of optimization passes and the function of each of the passes the ERUC software will execute each time an ERUC run is completed.
- Each pass will jointly optimize energy and all classes of operating reserves to minimize overall production costs.
- Each pass may use distinct inputs.

Importance and Relevance

- Number and design of passes affects the efficiency of the optimization.
- At least two passes will be necessary to incorporate market power mitigation.
- One pass may be used to account for the difference between forecasted average hourly demand and peak hourly demand.
- A larger number of passes will increase processing time.

Current Status for RT-GCG Program

- RT-GCG eligibility for NQS generators is based on their pre-dispatch schedules.
- Pre-dispatch has a single pass and determines least cost, security constrained schedules, jointly optimizing energy and operating reserve for each hour independently.
- Pre-dispatch uses the average demand forecast when the difference between average and peak demand is less than 300 MW; otherwise the peak demand forecast is used to reflect the ramp requirement.

Considerations for Options and Analysis

- The IESO will define the number and function of ERUC passes based on:
  - The need to implement the market power mitigation process.
  - The need to account for the difference in forecast average and hourly peak demand.
  - The trade-off between processing time to complete an ERUC run and the desired frequency of ERUC runs.

DESIGN ELEMENT NO. 2: LOOK-AHEAD PERIOD

Description – Look-Ahead Period

- Establishes the timeframe over which ERUC engine performs the optimization.
- Operational unit commitments will be initiated by the IESO based on optimization results completed for the look-ahead period.

End of Run	Lag time	Operating Hour (OH)	OH+1	+2	+3	+4	+5	+6	+7	+8	+9	+10

Multi-hour Look-ahead Period

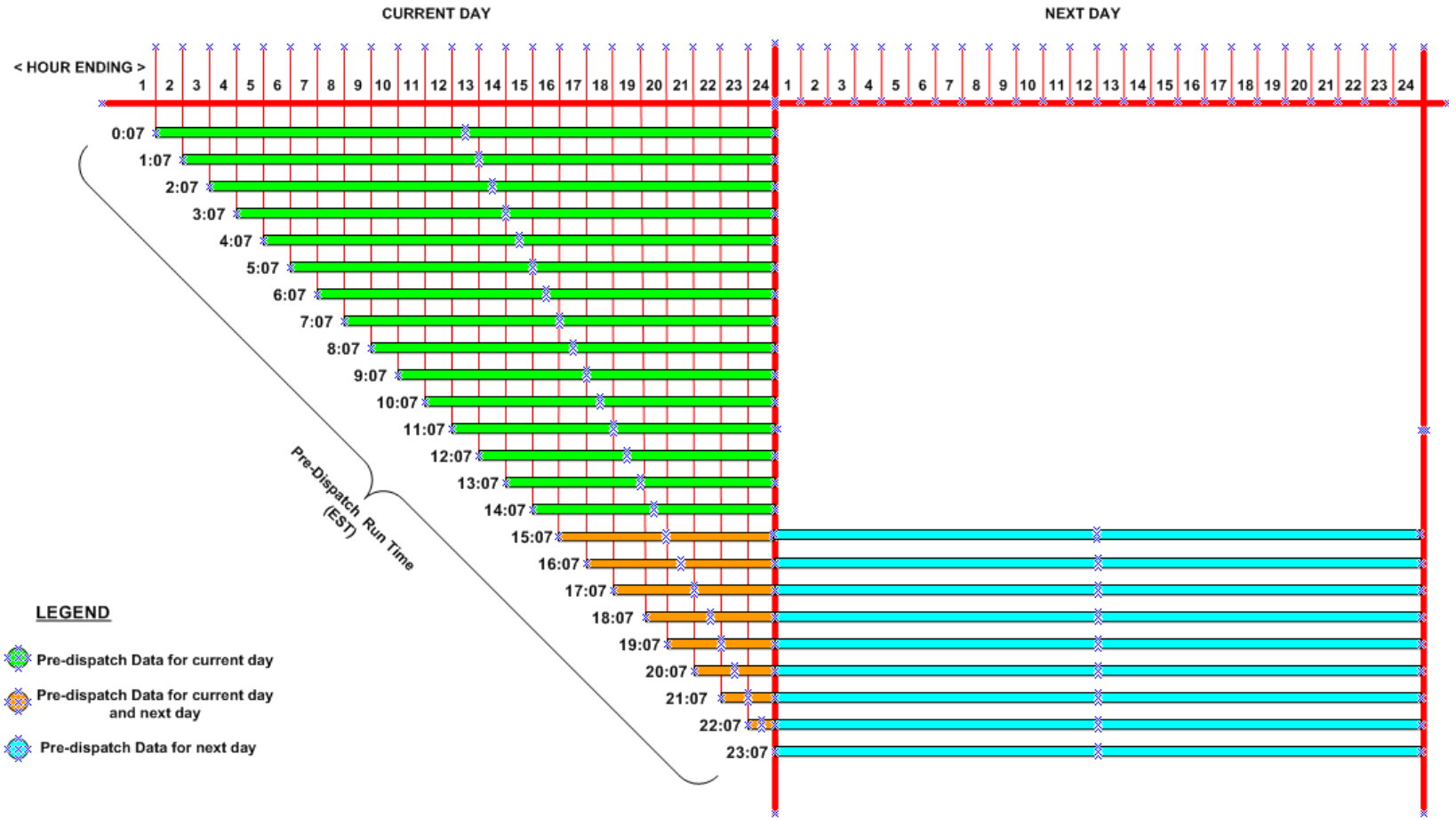
Importance and Relevance

- The look-ahead period establishes the extent to which commitment of resources with longer start-up, minimum run times and use-limit constraints (max. # of starts per day) can be economically evaluated.
- The length of the look-ahead period can affect the economic efficiency of the commitment.

Current Status for RT-GCG Program

- Look-ahead period for pre-dispatch, which determines eligibility for RT-GCG, is all remaining hours of the current day.
- Each hour is optimized independently.
- At 15:00, the look-ahead period expands to include all hours of the next day.

Current Status for RT-GCG



Considerations for Options and Analysis

- The look-ahead period will be based on several considerations:
  - A longer look-ahead period allows for a more complete economic evaluation of resources.
  - Optimization using a longer look-ahead period will be impacted by increased forecast uncertainty.
- Other jurisdictions: Look-ahead period varies ranging from only 2.5 hours to remainder of operating day.

Considerations for Options and Analysis

- Longer look-ahead period will increase the run time of the ERUC.
- Longer look-ahead period will allow for the evaluation of morning and evening peaks, which will determine if it is more efficient to keep a unit on versus starting it twice in one day.
- Shorter look-ahead period will preclude the evaluation of some units with longer run times.

DESIGN ELEMENT NO. 3: TIMING AND FREQUENCY OF RUNS

Description – Timing and Frequency of Runs

- Establishes when and how often the ERUC engine will run.
- This element addresses:
  - when the engine must run to provide sufficient notice for a resource to start-up to meet system needs; and
  - how often the engine must run to ensure that we meet needs in the most efficient manner possible.

Importance and Relevance

- Decisions about timing and frequency of runs will affect the efficiency with which the ERUC economic evaluation commits resources.
- A resource may be "notionally" included in the schedules of several ERUC runs but would only receive a commitment instruction when it needs to commence start-up.
- ERUC run timing will be aligned with intertie scheduling to incorporate up-to-date near term intertie schedules.

Current Status for RT-GCG Program

- Pre-dispatch is run every hour starting at about 00:07 past the hour, completing by about 00:15
- RT-GCG is usually invoked based on the results of the 3-hour ahead pre-dispatch run allowing the generator to synchronize in time to follow dispatch instructions.

Considerations for Options and Analysis

- The IESO will determine the timing of the ERUC runs based on:
  - The amount of time and operator attention necessary to complete the run, and
  - Coordination with near term scheduling of intertie transactions.

Considerations for Options and Analysis

- The IESO will determine the ERUC run frequency.
- Need to balance improved commitment decisions for those resources evaluated by ERUC against the time constraints to complete the run.
- Other jurisdictions: Frequency of short-term unit commitment run is hourly or every 15 minutes.

DESIGN ELEMENT NO. 4: TIME STEP

Description – Time Step

- Establishes the interval duration used for the ERUC optimization and the scheduling granularity used for commitment instructions.

Importance and Relevance

- The ERUC time step will affect the efficiency and precision with which ERUC commits units, especially to manage changes in load and variable generation forecasts.
- MFIS work stream is considering a 15-minute interval for intertie scheduling, and the choice of the ERUC time step could be aligned with the time step used for intertie scheduling.

Current Status for RT-GCG Program

- The pre-dispatch optimization, which is used for RT-GCG commitments and intertie scheduling, uses an hourly time step.
  - Commitment decisions for NQS generators are specified in whole hours
  - Current intertie schedules have an hour long duration
- Processes and tools that support or provide inputs to pre-dispatch are staffed/developed to support this hourly granularity.

Considerations for Options and Analysis

- The ERUC time step could be an hour like the current pre-dispatch time step, or could use a shorter time step.
- Further, ERUC could use more than 1 time step.
  - Near term hours could use a time step as small as 15 minutes and the time step could increase for hours further in the future.
- Other jurisdictions: time step varies ranging from 15/30/45/60 minutes, or a combination of these time steps.

Considerations for Options and Analysis

- We will consider the trade-offs between the use of shorter and longer time steps:
  - Shorter time steps can allow for better coordination with intertie scheduling and result in more precise analysis and better commitment decisions.
  - Longer time steps reduce run time and may allow for a longer look-ahead period.

Considerations for Options and Analysis

- More IESO resources will be required to support a more granular time step.
- The time step used will seek to balance run efficiency and coordination with other tools.

DESIGN ELEMENT NO. 5: INTERTIE TRANSACTIONS

Description – Intertie Transactions

- ERUC commitment decisions will consider bids and offers for intertie transactions that have a DAM or real-time schedule.
- However, we need to address whether or not ERUC will consider intertie transactions that have neither a DAM schedule nor a binding real-time schedule.

Importance and Relevance

- Intra-day unit commitment models require rules for whether and when to take into account intertie bids, offers and schedules, in order to optimize commitments and maintain reliability.
- A concern with accounting for intertie transactions in ERUC is that, when looking ahead multiple hours when system conditions are less certain, ERUC may commit generation to meet exports (or rely upon imports) that do not appear in real-time.

Current Status for RT-GCG Program

- All import offers and export bids are considered by the pre-dispatch engine.
- Exports generally participate in the pre-dispatch timeframe only.
- Additional NQS generators may be committed in pre-dispatch to support real-time exports.
- Real-time imports and exports evaluated by pre-dispatch in making commitment decisions may not materialize, leading to potentially inefficient internal load and generation schedules.

Considerations for Options and Analysis

- DAM will produce financially binding intertie schedules whose bids and offers will be used in ERUC runs.
- ERUC runs will also take account of near term pre-dispatch binding operational intertie schedules that reflect more up-to-date operating conditions.
- Other jurisdictions: The short look-ahead period of the NYISO and California ISO short-term commitment programs means that binding intertie bids/offers have been submitted for the evaluation horizon.

Considerations for Options and Analysis

- Modeling intertie transactions in ERUC requires consideration of whether and how to include intertie bids and offers that did not clear in the DAM in the evaluation of commitment decisions.
- IESO operators will continue to have the ability to de-rate DAM intertie schedules in the event operating conditions in adjacent systems change.

DESIGN ELEMENT NO. 6: MUST OFFER REQUIREMENTS

Description – Must offer requirements

- Establishes any required rules for market participants to submit offers for physical capacity in the ERUC timeframe.

Importance and Relevance

- Must offer requirements are intended to:
  - Support efficiency by increasing participation in the pre-dispatch timeframe, thereby increasing price convergence between DA and RT.
  - Ensure resources relied upon for resource adequacy offer in their capacity.
  - Mitigate the exercise of market power (i.e. physical withholding).

Importance and Relevance

- Any ERUC must-offer requirements need to ensure the following:
  - Sufficient resources are available to allow for reliability as well as competitive and efficient unit commitment analysis; and
  - Costs / demands are not imposed unnecessarily upon NQS generators and the gas market.

Current Status for RT-GCG Program

- There are no market based must offer obligations today that apply during the pre-dispatch timeframe.
- Under the market rules, participants are obligated to submit dispatch data when directed by the IESO in response to reliability issues.
- Currently, resources are incentivized under contractual structures and rate regulation to be available for dispatch in real-time.

Considerations for Options and Analysis

- It is expected that resources with a DAM schedule will have an incentive to offer in the ERUC timeframe, but must offer requirements could be applied.
- ERUC must-offer requirements could also be established for resources without a DAM schedule.
- Must-offer requirements could also apply to resources capable of providing operating reserve.

Considerations for Options and Analysis

- Other jurisdictions: Generation resources with capacity obligations typically subject to a must-offer requirement in post day-ahead market reliability commitment processes and real-time markets.
  - NYISO and MISO do not have a general real-time must-offer requirement except that NYISO requires some capacity resources to offer real-time reserves in eastern NY.
  - CAISO has a capacity procurement mechanism that allows it to dispatch resources without a capacity obligation under certain circumstances.

DESIGN ELEMENT NO. 7: ELIGIBILITY FOR COMMITMENT

Description – Eligibility for Commitment

- Establishes which resources can receive a binding commitment from ERUC and are eligible for real-time make whole payments for these commitments.

Importance and Relevance

- Generators need to understand eligibility requirements in order to appropriately offer supply into the market.

Current Status for RT-GCG Program

- In order to be eligible for a RT-GCG, a resource must be a dispatchable NQS generator with a registered MLP and MGBRT.
- They must be scheduled in a pre-dispatch schedule within 3 hours of real-time for at least half of their MGBRT hours at MLP or greater.

Considerations for Options and Analysis

- The same NQS generators that are currently eligible for RT-GCG will be eligible to receive an operational commitment and make whole payment, if applicable, once they are committed by ERUC.
- Generators must have an elapsed time to dispatch greater than 1 hour to be eligible for commitment in ERUC.

DESIGN ELEMENT NO. 8: MARKET PARTICIPANT DATA

Description – Market Participant Data

- Establishes the bid and offer data and non-price offer parameters associated with market participant resources that are necessary for ERUC to economically evaluate unit commitment.
- ERUC will consider three-part offers (energy, speed-no-load and start-up costs) and non-price offer parameters.

Importance and Relevance

- This data will allow ERUC to determine the most efficient commitments considering all resources, and respect the operating characteristics of NQS generators.

Current Status for RT-GCG Program

- The current optimization is based on single-part energy offers for all resources.
- Each hour is optimized independently, not considering operating parameters such as MLP and MGBRT.

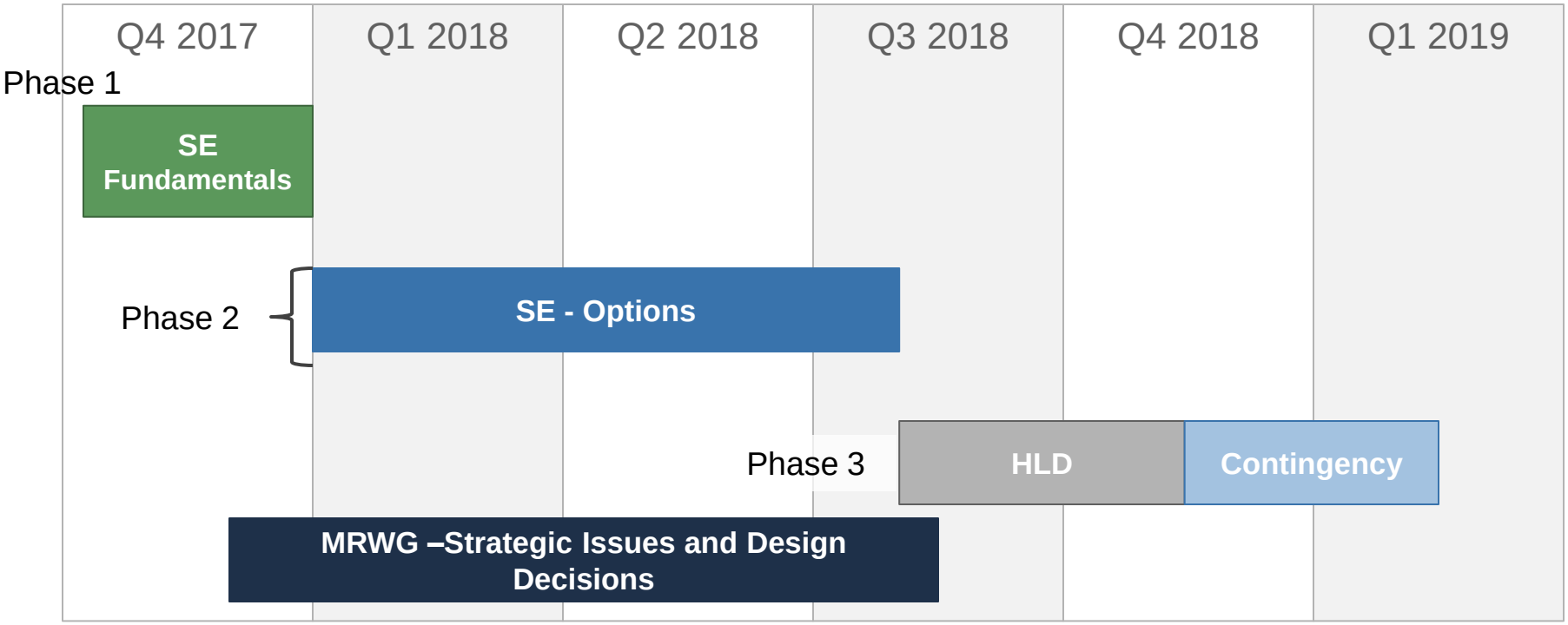
Considerations for Options and Analysis

- ERUC will take into account resource operational constraints (i.e. lead time, MGBRT, MLP, MGBDT, ramp rates above MLP, and max. # of starts per day).

- It is expected that the only new NQS generator data will be **lead time**.
  - ERUC will need to know how long it will take for a generator to initiate start-up and ramp to MLP.
  - This time may depend on the state of the generator (hot, cold) and actions taken by the generator to enable it to come on line quickly.

END OF MODULES A & B

ERUC Timelines



ERUC - HLD Schedule

- Three phases of High Level Design to continue through approximately Q4 2018

- Near-term schedule (End of Phase 1 & Start of Phase 2):

Date	Forum	Topic
Monday, November 27 (afternoon)	ERUC	Fundamentals mtg. 2
January 2018	ERUC	Options mtg. 1

Next Steps

- Questions for stakeholders:
  - Additional issues to consider for options and analysis?
  - Are there elements that require additional education or clarification?

- Stakeholder feedback due Nov 10, 2017
  - IESO to address feedback ahead of or at the next meeting on Nov 27, 2017