

Single Schedule Market Pricing Issues

**Presented by
Scott Harvey and Susan Pope**

Phase 1 - Session 2

Module E: Pricing Operating Restrictions and Operator Actions

June 2, 2017
Toronto, Ontario



MODULE E: PRICING OPERATING RESTRICTIONS AND OPERATOR ACTIONS

The discussion in prior modules has progressively introduced fundamental SSM concepts:

- Locational variations in prices due to congestion and losses.
- Co-optimization of energy and reserve prices.
- The role of constraint violation penalty functions in price formation.
- Impact of multi-interval dispatch optimization on prices.

The prior discussion takes into account physical operating limits, such as transmission constraints, that can be readily addressed within the constrained dispatch optimization models used to calculate SSM prices.

Rules are needed to set SSM prices in two situations that are not readily addressed by constrained pricing model runs:

- Dispatch of suppliers with physical operating restrictions.
- Operator interventions in the physical dispatch.

Rules will be needed to prevent counter intuitive pricing signals that are inconsistent with the physical dispatch or system conditions.

Not all generation supply can be dispatched up and down one megawatt at a time.

- Thermal generators generally cannot stably operate below a certain megawatt level; this is known as their “minimum load”.
- Fast-starting gas turbines often have minimum load levels equal to, or almost equal to, their normal maximum level of output.
- Interchange transactions are modeled as fixed block schedules.
- Some generators have “forbidden regions”, which are output ranges that the generator must ramp through to avoid operating problems.
- Some suppliers request the IESO to apply constraints on their behalf to address concerns related to safety, equipment or applicable law.

Because suppliers with operating restrictions cannot increment or decrement their output one megawatt at a time, their physical dispatch can cause discrete changes in the dispatch points of other units.

- A common situation is that a block-loaded gas turbine, generally one which can be committed and started-up quickly - close to real-time - may be needed on the margin to serve load.
 - For example, if only 30 MW of an 80 MW block loaded unit is needed, then the dispatch of another supplier must be reduced by 50 MW.
 - The decremented supplier may have a lower marginal offer cost than the average offer cost of the block loaded unit.

When an operating restriction results in a discontinuous physical dispatch on the margin, the SSM pricing run rules must explicitly address how this will be taken into account in calculating prices, taking the physical commitment and dispatch as optimal.

- Continuing the prior illustration, if 30 MW of an 80 MW block loaded unit is part of the least-cost dispatch, should the LMP be:
 - The average offer cost of the block loaded unit? This unit was needed to serve load.
 - The incremental offer cost of the cheapest supplier whose dispatch was reduced to accommodate the extra 50 MW of the block-loaded unit's output? This is the incremental offer cost to serve an increment of load.

OPERATING RESTRICTIONS Status Quo: Unconstrained

When determining the MCP in today's unconstrained schedule the following operating restrictions are eligible for partial scheduling and can set the unconstrained price:

- Minimum load blocks of on-line internal resources.
- Minimum load blocks of off-line quick start resources (5-minute dispatch time frame)
- Forbidden regions

In the unconstrained schedule the following operating restrictions are not eligible for partial scheduling and cannot set the unconstrained price:

- Interchange transactions.
- Operating ranges scheduled to provide regulation.

Conversely, in the constrained schedule today the following operating restrictions are not eligible for partial scheduling:

- Minimum load blocks of on-line internal resources
- Minimum load blocks of off-line quick start resources (5-minute dispatch time frame)
- Interchange transactions.
- Operating ranges scheduled to provide regulation.
- Forbidden regions.

Each of these operating restrictions may need to be addressed with special rules in the pricing run used for SSM settlements.

In the NYISO, MISO and, prospectively, ISO New England, the minimum load blocks of some *online* resources are treated as dispatchable in the SSM pricing run.

- The resources treated as dispatchable in these markets typically have minimum run times of an hour or less and have typically been able to start within 10-minutes.
- The MISO proposes to extend this price setting to resources able to start within an hour.
- The California ISO and PJM rules for allowing the minimum load blocks of some resources to set prices are so limited that they have essentially no impact.

In the NYISO and MISO certain *offline* fast start resources also are eligible to set price.

In the U.S. the federal regulator has proposed requiring all ISOs to have rules allowing the minimum load blocks of online resources that can be started in 10-minutes or less and have a minimum run time of an hour or less to set prices.

- Such a pricing design for online resources has worked well in the New York ISO markets for many years.
- Pricing rules for off-line block loaded resources originated to address situations in which operators did not commit resources that were economic in the dispatch because they judged that the commitment of these resources was unnecessary. These operator interventions may occur less frequently today.

The use of fixed block pricing rules in future years needs to be carefully evaluated in light of changes in resource mix, real-time commitment and look-ahead optimization model capabilities and operating practices (particularly 15 minute interchange scheduling and coordinated interchange scheduling).

The rules for whether and when the minimum load blocks of on-line and off-line units may set price under SSM will need to take into account:

- The capabilities of the commitment models the IESO runs close to real-time.
- The variability of net load.
- The time step for interchange scheduling.
- How many resources with minimum load blocks that can be committed in 10 minute or less with a minimum run time of an hour or less will likely be included in the Ontario resource mix in future years.

IESO operators may take a number of actions to maintain electric system reliability during shortage conditions.

These actions include:

- Voltage reductions
- Export curtailments
- Emergency imports/exports.

Other operator actions that can be taken to maintain local electric system reliability that could impact prices include:

- Supplying emergency curtailable exports to adjacent control areas that are counted as Ontario operating reserves
- Curtailing imports during low load conditions
- Committing resources out of merit to provide voltage support, operating reserves or address area control error
- Committing resources out of merit for transmission security
- Constraining off energy limited resources in order to be able to meet load later in the operating day.

These out-of-market operator actions increase energy supply or reduce demand, so that the prices produced by pricing model runs can understate the degree of regional or local scarcity in the market.

- SSM prices should avoid sending inaccurate price signals to the market triggered by out-of-market operator actions.
- The unconstrained prices in Ontario today do not take into account the load reducing impact of out-of-market operator actions.

Key Takeaways

Key Takeaways

Many modeling elements needed or desirable for SSM are already part of the IESO's constrained schedule:

- The current energy shadow prices are “raw” LMPs and the current reserve prices are raw SSM reserve settlement prices.
- The energy and reserve shadow prices in the IESO's current constrained schedule are co-optimized and are inter-related (i.e., cascade) in a manner similar to the best practice in other SSM markets.
- The IESO currently performs a multi-interval optimization in its constrained schedule.
- The IESO uses soft constraints in its constrained schedule.
- The cost of marginal losses is included in the constrained schedule.

Key Takeaways

The constrained schedule used by the IESO today can be modified into a corresponding SSM pricing run by making some specific decisions and changes.

- Evaluate how to include the cost of constraint violations in pricing.
- Evaluate changes in the level of some or all constraint penalty prices for purposes of pricing.
- Determine pricing rules to account for operating restrictions with marginal impacts on physical dispatch.
- Determine pricing rules to apply in intervals where out-of-market actions are required for reliability.