Multi-Interval Optimization

Introduction

This Quick Take explains Multi-Interval Optimization (MIO), a feature of the software we use to determine dispatch instructions.

How MIO Helps

With MIO, the dispatch scheduling optimizer (DSO) software considers a number of future intervals to determine optimal dispatch instructions, rather than considering just a single interval. Without using MIO, participants would be adversely affected, such as:

- Excessive cycling of generators due to unexpected dispatch instructions can cause generators unnecessary stresses and wear
- Unpredictable dispatch instructions make it difficult for generators with fuel restrictions (e.g., hydroelectric units) to efficiently manage their operation
- Increased instances of constraining units on or off triggers corresponding payments for congestion management settlement credits

Dispatch instructions for the next five-minute interval are based on this 'multi-interval optimization.' In addition to dispatch instructions, we also issue dispatch advisories for future 'critical intervals.' These dispatch advisories give you an indication of how your units may be dispatched in the near future.

Overall, MIO allows the DSO to produce a more efficient dispatch with reduced congestion management settlement credits, reduced wear and tear on generators and a more predictable dispatch for generators with fuel restrictions.

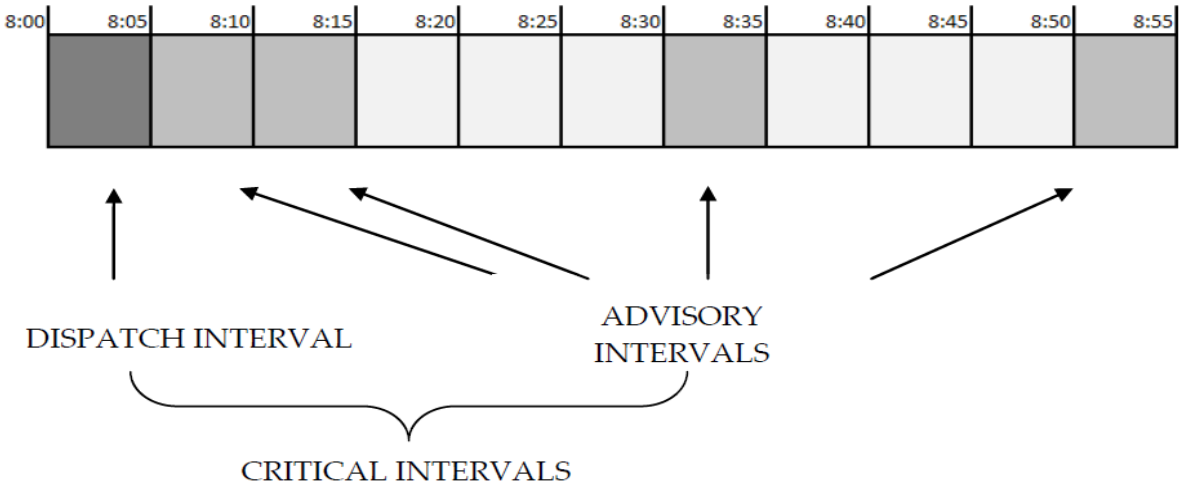
Selecting critical intervals

With MIO, the DSO sets dispatch instructions for the next interval by considering five 'critical' intervals in the 'study period' of the next 11 intervals.

We have two goals when we select critical intervals:

- To provide the most efficient dispatch

- To provide the most beneficial information to facility operators



The DSO uses the following rules to select the critical intervals:

- Select the first interval in the study period
- Select the second interval in the study period
- Select xx:05 and xx:55 if they are in the study period
- Select the last interval if fewer than four intervals are selected so far
- Select the third interval if fewer than four intervals are selected so far
- Select the minimum or maximum load interval in the largest gap
- Select the last interval if it is in the largest gap or if more than one interval is unselected at the end of the study period

Example of Improved Efficiency

MIO enhances reliability by looking at future demand requirements. For example, MIO recognizes ramp rate restrictions in future intervals and dispatches slow-ramping resources in advance of their need. This avoids the need to use more expensive resources with faster ramp capability in later intervals.

The dispatch example below shows how MIO can dispatch resources more efficiently. Table 1 shows generator costs, and Tables 2 and 3 have dispatch examples that show the effect MIO has on dispatch instructions.

	Offer Price	MW Quantity	Ramp Rate in MW/min
Generator A	$40	100	10
Generator B	$50	100	7
Generator C	$200	100	15

Table 1 - Resource Cost

Table 2 shows five dispatch intervals using single five-minute interval optimization. In this case, we can see that in each interval the dispatch scheduling algorithm dispatches to meet current conditions at the lowest cost.

Interval	1	2	3	4	5
Generator A	50	100	100	100	100
Generator B	0	0	35	70	100
Generator C	0	0	15	15	0
Demand in MW	+50	+50	+50	+35	+15
Cost/Interval	$2,000	$4,000	$8,750	$10,500	$9,000
Total Cost	**$34,250**				

Table 2 - Single Interval Optimization

Table 3 shows five intervals using MIO. Here we can see that costs have been optimized over the five intervals for a lower overall cost. The slower ramping and cheaper Generator B was preloaded starting in interval 2 in order to meet the future requirements in intervals 3 and 4.

Interval	1	2	3	4	5
Generator A	50	85	100	100	100
Generator B	0	15	50	85	100
Generator C	0	0	0	0	0
Demand in MW	+50	+50	+50	+35	+15
Cost/Interval	$2,000	$4,150	$6,500	$8,250	$9,000
Total Cost	**$29,900**				

Table 3 - Multi-Interval Optimization

Benefits of MIO

Improved Operational Reliability - MIO can enhance reliability by looking at future interval demand requirements. For example, MIO can recognize ramp rate restrictions in future intervals and dispatch slow-ramping resources in advance of their need. Without MIO, the DSO looks for available resources to fill ramping need in each interval, often dispatching more expensive resources with faster ramp capability or fast-ramping energy limited resources, such as hydro facilities.

Operational Stability - A longer optimization period also provides smoother dispatch instructions. In Table 2, Generator C started and ran for two intervals. In Table 3, the MIO solution pre-loaded Generator B, eliminating the short start/stop sequence for Generator C. Reducing short start/stop sequences results in less wear and tear on equipment, increasing overall resource availability.

Improved Compliance - With MIO, dispatch advisories inform participants of expected future dispatches. Knowing future dispatch targets allows participants to proactively position their resources to comply with these future requirements.

Reduced Constraint Payments - When ramping restrictions occur under single-interval optimization, we might dispatch higher priced resources to meet the ramp rate requirements, even when these resources are not economic. If dispatched resources are uneconomic, they may receive constraint payments. With MIO, lower cost resources are dispatched in advance of ramp rate restrictions in order to meet those future ramp rate requirements. This reduces overall constraint payments.

Receiving Dispatch Advisories

We issue dispatch advisories to dispatchable market participants every five minutes. Dispatch advisories show anticipated dispatch targets and operating reserve schedules for the four selected advisory intervals in the 55-minute study period.

The dispatch advisory report does **not** contain the dispatch instruction. These advisories should help you to proactively manage the transition to potential new dispatch instructions.
You can access your confidential dispatch advisory reports on the IESO Reports webpage with a user name and password. Dispatch advisories are formatted in XML - see *Quick Take - Accessing IESO Reports Formatted in XML* on the Training Materials webpage for more information.

Keep in mind that with MIO, your obligation to follow your dispatch instruction remains unchanged. Dispatch advisories are intended only to show anticipated schedules and may be recalculated several times before becoming dispatch instructions.

Example of a Dispatch Advisory Report

Dispatch Advisory Report

For Some Co.
Created at Apr 06, 2009 10:16:46 a.m.
For Apr 06, 2009 Dispatch Interval HE 11: Int 5

Resource	Energy(MW)				10MinSync(MW)				10MinNonSync(MW)				30MIN(MW)			
	Hour:Interval				Hour:Interval				Hour:Interval				Hour:Interval			
	11:6	11:11	12:1	12:3	11:6	11:11	12:1	12:3	11:6	11:11	12:1	12:3	11:6	11:11	12:1	12:3
Resource 1	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Resource 2	37	37	85	85	148	148	148	148	148	148	148	148	0	0	0	0
Resource 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource 5	157	157	157	166	0	0	0	0	0	0	0	0	0	0	0	0
Resource 6	170	170	170	110	30	30	30	30					150	150	150	150

Additional Resources

For more details about reports, see *QT - Retrieving Reports via IESO Reports Site*, available on our Training Materials webpage, which provides instructions for viewing reports via the IESO Reports site.

Introduction to Ontario's Physical Markets workbook includes a detailed explanation of how Ontario's wholesale electricity prices are determined, and is available on the Training Materials page.

Contact Us

For additional information, please contact us at:

Toll Free: 1-888-448-7777
Tel: (905) 403-6900
Email: customer.relations@ieso.ca

IESO Quick Takes provide the Ontario electricity sector with insights into specific initiatives or issues. Market participants should ensure that they read and understand the specific obligations in the market rules and market manuals for their participation in Ontario's electricity market. For more information, please email us at customer.relations@ieso.ca.