



Market Rule Amendment Proposal

PART 1 – MARKET RULE INFORMATION

Identification No.:	MR-00263-R00		
Subject:	Market Clearing and Pricing Process		
Title:	Non-Material Discrepancies in Dispatch Scheduling Algorithm Description – Static Transmission Losses		
Nature of Proposal:	<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion	<input type="checkbox"/> Addition
Chapter:	7	Appendix:	7.5
Sections:	2.4		
Sub-sections proposed for amending:	2.4.5		

PART 2 – PROPOSAL HISTORY

Version	Reason for Issuing	Version Date
1.0	Submit for Technical Panel Review and Vote	9 Feb 04
2.0	Incorporate Technical Panel changes; Recommended by Technical Panel; Submitted for IESO Board Approval	15 Feb 04
3.0	Approved by IESO Board	2 Jun 05
Approved Amendment Publication Date:	June 6, 2005	
Approved Amendment Effective Date:	September 14, 2005	

PART 3 – EXPLANATION FOR PROPOSED AMENDMENT

Provide a brief description of the following:

- The reason for the proposed amendment and the impact on the *IMO-administered markets* if the amendment is not made.
- Alternative solutions considered.
- The proposed amendment, how the amendment addresses the above reason and impact of the proposed amendment on the *IMO-administered markets*.

Summary

It is proposed to make four non-material corrections to the market rules description of the real-time market dispatch scheduling algorithm. An independent review of the dispatch scheduling algorithm and related dispatch processes and procedures in 2004 identified the need for three of these corrections. These discrepancies are with respect to the specification of transmission loss penalty factors, nodal price calculation and ramp rates. The need for the fourth correction, related to the description of the tie-breaking, was identified during the development of the multi-interval optimization enhancements in 2004.

Although the discrepancies are non-material in nature, they should be corrected in order to reduce the potential for confusion regarding the operation of the dispatch scheduling algorithm.

It is also proposed that all references to the IMO be changed to the IESO in all Chapter 7 appendices to reflect the name change required under Bill 100.

Background

Under the market rules (chapter 7 section 4.2.4) the IESO is required to commission a periodic independent review of the dispatch scheduling algorithm and related dispatch processes and procedures. As part of that review undertaken in 2004, a number of non-material discrepancies were identified in the market rule specification of the dispatch algorithm i.e. the market rules do not correctly identify what the algorithm is actually and properly doing.

As part of the multi-interval optimization initiative it was discovered that the description of the tie-breaking mechanism was not accurate and could be misleading.

Discussion

Section 2.4.5 of Appendix 7.5 states “Transmission losses shall be calculated using an AC power flow and shall be modeled using penalty factors for the power balance requirements”. This provision describes a relationship between dynamic transmission losses determined by the AC power flow solution and the power balance. However, the IESO actually incorporates transmission losses into the power balance by adjusting offer and bid prices by **static** transmission loss penalty factors. This treatment was introduced prior to market commencement (refer to MR-00193) to reduce the volatility in dispatch of resources in response to small changes in transmission losses as determined using the AC power flow analysis.

MR-00193 amended sections 4.6.2 and 5.1 of Appendix 7.5 to incorporate the use of static transmission loss penalty factors. Section 2.4.5 of Appendix 7.5 should have been amended at that time as well, but was inadvertently overlooked.

PART 3 – EXPLANATION FOR PROPOSED AMENDMENT

It is proposed to make the changes to section 2.4.5 of Appendix 7.5 to reflect the use of static transmission loss penalty factors.

It is also proposed that all references to the IMO be changed to the IESO in all Chapter 7 appendices to reflect the name change required under Bill 100.

PART 4 – PROPOSED AMENDMENT**2.4 The IMO-Controlled Grid**

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2.4.5

The IESO shall estimate static transmission losses and model transmission losses using penalty factors. The IESO shall adjust bid and offer prices using the applicable penalty factor. The IESO shall notify market participants in a timely manner of any changes to the applicable penalty factors. ~~Transmission losses shall be calculated using an AC power flow and shall be modelled using penalty factors for the power balance requirements.~~

PART 5 – IMO BOARD COMMENTS

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Market Rule Amendment Proposal

PART 1 – MARKET RULE INFORMATION

Identification No.:	MR-00263-R01		
Subject:	Market Clearing and Pricing Process		
Title:	Non-Material Discrepancies in Dispatch Scheduling Algorithm Description – Nodal Price Calculation		
Nature of Proposal:	<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion	<input type="checkbox"/> Addition
Chapter:	7	Appendix:	7.5
Sections:	6.7		
Sub-sections proposed for amending	6.7.1		

PART 2 – PROPOSAL HISTORY – PLEASE REFER TO MR-00263-R00

Version	Reason for Issuing	Version Date
Approved Amendment Publication Date:		
Approved Amendment Effective Date:		

PART 3 – EXPLANATION FOR PROPOSED AMENDMENT

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- Alternative solutions considered.
- The proposed amendment, how the amendment addresses the above reason and impact of the proposed amendment on the *IMO-administered markets*.

Summary

Please refer to MR-00263-R00.

Background

Please refer to MR-00263-R00.

Discussion

The equation defining how nodal prices are to be calculated is not consistent with the optimization objective function. Section 6.7.1 of Appendix 7.5 describes the relationship of the Nodal Prices to the shadow prices of constraints and the sensitivity factors of transmission and security constraints. The current equation is as follows:

$$I_n = I_s + (DF_n - 1) * I_s + \sum_k a_{nk} * m_k$$

where:

I_n nodal price at an injection or withdrawal node n (i.e., a node connected to a *generation facility* or *load facility*)

I_s system marginal cost

DF_n delivery factor for node n (reciprocal of penalty factor)

a_{nk} sensitivity factor for injection at node n on *transmission* line k

m_k shadow price for *transmission* line k constraint

The equation as currently written is not correct given the description of the Objective Function in Appendix 7.5 and does not reflect changes to the software that correct for an omission. Specifically the product within the summation expression on the right hand side of the equation should also be multiplied by the Delivery Factor (DF_n) corresponding to node “n”. The correct equation is:

$$I_n = I_s + (DF_n - 1) * I_s + \sum_k \underline{DF_n} * a_{nk} * m_k$$

PART 4 – PROPOSED AMENDMENT**6.7 Nodal Price Calculation**

$$6.7.1 \quad I_n = I_s + (DF_n - 1) * I_s + \sum_k \frac{DF_n}{DF_n} * a_{nk} * m_k$$

where:

- I_n nodal price at an injection or withdrawal node n (i.e., a node connected to a *generation facility* or *load facility*)
- I_s system marginal cost
- DF_n delivery factor for node n (reciprocal of penalty factor)
- a_{nk} sensitivity factor for injection at node n on *transmission* line k
- m_k shadow price for *transmission* line k constraint

- 6.7.2 Nodal prices may be decomposed into an *energy* component, a loss component, and a component for all other *transmission* and system constraints (the three terms on the right hand side, respectively.)

PART 5 – IMO BOARD COMMENTS

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Market Rule Amendment Proposal

PART 1 – MARKET RULE INFORMATION

Identification No.:	MR-00263-R02		
Subject:	Market Clearing and Pricing Process		
Title:	Non-Material Discrepancies in Dispatch Scheduling Algorithm Description – Ramp Rates		
Nature of Proposal:	<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion	<input type="checkbox"/> Addition
Chapter:	7	Appendix:	7.5
Sections:	7.6		
Sub-sections proposed for amending	7.6.1		

PART 2 – PROPOSAL HISTORY - PLEASE REFER TO MR-00263-R00

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Summary

Please refer to MR-00263-R00.

Background

Please refer to MR-00263-R00.

Discussion

The current market rules inconsistently describe the ramp rates and related constraints in the real-time market and dispatch schedules. Section 7.6.1 of Appendix 7.5 states: “The market constraints for ramping are identical to the ramping *dispatch* constraints used in the *pre-dispatch* and the *dispatch interval* of the *real time* multi-interval *dispatch*, as described in section 6.5.” However, section 6.4.2 of Chapter 7 lists a number of potential differences in the data used between the real-time market and real-time dispatch schedules. These differences include facility ramping capability and initial conditions. Section 7.6.1 should be amended to recognize these differences between the real-time market and dispatch schedules.

PART 4 – PROPOSED AMENDMENT**7.6 Ramping**

- 7.6.1 The mathematical description of the ~~The~~ market constraints for ramping ~~is~~ are identical to the mathematical description of the ramping *dispatch* constraints used in the *pre-dispatch* and the *dispatch interval* of the *real time* multi-interval *dispatch*, as described in section 6.5, except for the information and data differences specified in section 6.4 of Chapter 7.

PART 5 – IMO BOARD COMMENTS

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Market Rule Amendment Proposal

PART 1 – MARKET RULE INFORMATION

Identification No.:	MR-00263-R03		
Subject:	Market Clearing and Pricing Process		
Title:	Non-Material Discrepancies in Dispatch Scheduling Algorithm Description – Tie-Breaker		
Nature of Proposal:	<input checked="" type="checkbox"/> Alteration	<input type="checkbox"/> Deletion	<input type="checkbox"/> Addition
Chapter:	7	Appendix:	Appendix 7.5
Sections:	2.8		
Sub-sections proposed for amending:	2.8.1; 2.8.2; 2.8.3		

PART 2 – PROPOSAL HISTORY - PLEASE REFER TO MR-00263-R00

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Summary

Please refer to MR-00263-R00.

Background

Please refer to MR-00263-R00.

Discussion

Tie-breaking within the dispatch scheduling algorithm is necessary to prevent the random selection of different dispatchable facilities offering or bidding at the same price. Such an outcome could result in unacceptable cycling of dispatchable facilities as random selections are made every 5-minute dispatch interval.

The tie-breaking mechanisms introduced prior to market commencement results in the separate prorating of energy and operating reserve offers or energy bids on the basis of the amount of energy or operating reserve offered or bid.

The existing market rules description of the tie-breaking mechanism could be misleading as it states that the prorating is based on the amount offered or bid at the offer/bid price. In fact, the prorating is done on the basis of an **adjusted** amount offered or bid. The adjustment made is to recognize any physical limitations of the facility associated with the facility e.g. ramp limitations, deratings. This adjustment is necessary so that the prorating is based on the actual capability of the facilities.

In order to eliminate the possibility of misinterpretation, it is proposed that the description of the tie-breaking mechanism specify that the offer and bid quantities are adjusted to reflect the current capability of the facility.

PART 4 – PROPOSED AMENDMENT

2.8 Tie-Breaking

- 2.8.1 If two or more *energy offers* have the same *offer price* and interactions with the *operating reserve market* do not create differences in the cost to the market of utilising each *offer*, the schedules from these *offers* shall be prorated based on ~~the~~ an adjusted amount of *energy offered* at that *offer price*. The adjustment shall reflect the current capability of the facility by including any current limitations on the facility e.g. ramping, deratings.

- 2.8.2 If two or more *energy bids* have the same *bid* price and interactions with the *operating reserve market* do not create differences in the cost to the market as a whole of utilising each *bid*, the schedules from these *bids* shall be prorated based on ~~the~~ an adjusted amount of *energy bid* at that *bid* price. The adjustment shall reflect the current capability of the facility by including any current limitations on the facility e.g. ramping, deratings.
- 2.8.3 If two or more *offers* for a given class of *operating reserve* have the same *offer* price and provided that interactions with the *energy* market and markets for other classes of *operating reserve* do not create differences in the cost to the market as a whole of utilising each *offer*, then the schedules from these *offers* shall be prorated based on ~~the~~ an adjusted amount of *operating reserve offered* at that *offer* price. The adjustment shall reflect the current capability of the facility by including any current limitations on the facility e.g. ramping, deratings.

PART 5 – IMO BOARD COMMENTS

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