

PUBLIC

## WESM Manual

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# SEGREGATION OF LINE RENTAL TRADING AMOUNTS

## Issue 1.0

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Abstract	This documents the manner of computing line rental trading amounts in the Philippine Wholesale Electricity Spot Market, and determines the methodology for segregating line rental trading amounts into amounts associated with cost of losses and of congestion.
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	ERC Decision, ERC Case No. 2008-083 MC, In Re: Petition for Dispute Resolution / Manila Electric Company v. Philippine Electricity Market Corporation et al, 10 March 2010
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## Table of Contents

1. INTRODUCTION .....	1
2. PURPOSE .....	2
3. SCOPE OF APPLICATION .....	3
4. DEFINITIONS .....	3
5. REFERENCES .....	3
6. RESPONSIBILITIES .....	4
7. DETERMINATION OF LINE RENTAL TRADING AMOUNT .....	4
8. SEGREGATION OF LINE RENTAL TRADING AMOUNTS BY COMPONENT...	5
9. PROCEDURE FOR PROVIDING LINE RENTAL TRADING AMOUNT INFORMATION .....	6
10. APPENDIX .....	6

## 1. INTRODUCTION

- 1.1. The WESM adopts the locational pricing principle where resulting prices, called locational marginal prices (LMP) or nodal prices, differ across several locations in the power system. The differences in LMP are attributable to the costs associated with transmission losses and constraints in the operation of the electricity network. In other words, LMP consists of the system marginal price based on the marginal plant offer adjusted by the price of transmission loss and congestion.<sup>1</sup>
- 1.2. The WESM also adopts the gross pool concept where all energy, including quantities covered by bilateral contracts, are scheduled through the market.<sup>2</sup> However, quantities covered by bilateral contracts are settled by the parties outside the WESM settlement processes. Thus, the cost of losses and congestion associated with bilateral contract quantities (BCQ) are billed by the Market Operator as line rental trading amounts.
- 1.3. Line rental trading amount is the economic rental arising from the use of a transmission line, calculated as the difference in value between flows out of the receiving node of that line and flows into the sending node.<sup>3</sup> Simply put, the line rental trading amount is the difference in value between the LMP of the customer (receiving node) and the generator (sending node) multiplied by the applicable BCQ.
- 1.4. The line rental trading amount is payable to the Market Operator by the relevant trading participant. The WESM Rules require the bilateral contract parties to identify which party will pay the line rental trading amount associated with their declared BCQ.<sup>4</sup> Unless otherwise specified, it is the customer that pays for line rental trading amounts in the WESM.
- 1.5. The WESM Rules particularly provide as follows –
  - 1.5.1. The Market Operator shall calculate the line rental trading amounts for each transmission line in the market network model as:
    - 1.5.1.1. The expected flow of energy out of the receiving node of the market network line as determined by the market dispatch optimization model multiplied by the ex-ante nodal energy settlement price at that node; less
    - 1.5.1.2. The expected flow of energy into the sending node multiplied by the ex-ante nodal energy settlement price at that node of

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<sup>1</sup> PDM Decision, page 21.

<sup>2</sup> PDM Decision, page 18.

<sup>3</sup> WESM Rules, Glossary.

<sup>4</sup> WESM Rules clause 3.13.1.1 (b)

the market network line as determined by the market dispatch optimization model.<sup>5</sup>

1.5.2. Trading Participants who sell electricity pursuant to bilateral contracts and wish those bilateral contracts to be accounted for in settlements shall, after each trading day, in accordance with the billing and settlements timetable:

1.5.2.1. Submit a schedule to the Market Operator specifying the MWH bilateral sell quantities at each relevant market trading node, in each trading interval of that trading day;

1.5.2.2. Identify the counterparty to the bilateral contract and the party that will pay the line rental trading amount associated with the bilateral contract quantity submitted; provided, however, that in case only one of the bilateral counter parties is registered as a Direct WESM Member, that WESM Member shall be the party that will pay the line rental trading amount to the Market Operator; and

1.5.2.3. Provide evidence that the counterparty to the bilateral contract agrees with the submission made.<sup>6</sup>

1.6 In a decision dated 10 March 2010, the Energy Regulatory Commission (ERC) found double charging in the transmission costs between a generator and a customer involved in a dispute filed before it and thus directed PEMC to provide the parties with "segregated line rental trading amounts" for their BCQ "including actual line losses embedded in said line rental trading amounts" to allow the parties to determine their appropriate line loss charge. PEMC then requested to be allowed to be given sufficient time to submit alternative methodologies with the possibility of segregating line rental congestion cost and line losses.

In an order dated 7 March 2011, the ERC allowed PEMC to submit an alternative methodology for the segregation of line rental into congestion cost and line losses for the ERC's additional input in coming up with an expedient means of implementing the segregation of line rental to determine the over and under-recoveries in the past billing months and to prevent double recovery on line losses from occurring henceforth.

## **2. PURPOSE**

2.1. This document implements the above-mentioned directives of the Commission. It specifically documents the following –

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<sup>5</sup> WESM Rules, 3.13.12.

<sup>6</sup> WESM Rules, 3.13.1.1.

- 2.1.1. Manner by which line rental trading amounts are computed in the WESM;
- 2.1.2. Methodology for segregating line rental trading amounts into those associated with the cost of losses and of congestion; and
- 2.1.3. Procedure for providing participants with line rental trading amount information, including data on transmission loss cost and congestion cost for validation.

### **3. SCOPE OF APPLICATION**

- 3.1. The methodology and procedure set in this document applies to all trading participants registered in the WESM and the Market Operator.
- 3.2. This Manual documents, but does not introduce a new methodology, for determining line rental trading amounts in the WESM. Such is already embodied in the WESM Rules and in the WESM PDM. The methodology introduced in this document covers the segregation of the components of line rental trading amounts into amounts associated with the cost of losses and of congestion, in compliance with the directives of the Commission.
- 3.3. The methodology for the segregation of the components of line rental trading amounts set in this document shall be applied prospectively.
- 3.4. Consistent with the net settlement concept where bilateral contracts are settled outside of the WESM, the refund or collection of line rental trading amounts associated with transmission loss costs between parties to a bilateral contract is extraneous to this document. Such refund or collection shall be carried out outside the WESM, pursuant to the provisions of the parties' bilateral contracts and the rulings that the Commission may make on the matter.

### **4. DEFINITIONS**

All terms in this document will have the same meaning as defined in the WESM Rules and the WESM Price Determination Methodology unless the context provides otherwise.

### **5. REFERENCES**

This document should be read together with the –

- 5.1. WESM Rules as amended

- 5.2. WESM Price Determination Methodology
- 5.3. ERC Decision, In the Matter of the Application for Approval of the Price Determination Methodology for the Philippine Wholesale Electricity Spot Market, ERC Case No. 2006-007 RC, 21 June 2006.
- 5.4. ERC Decision, ERC Case No. 2008-083 MC, In Re: Petition for Dispute Resolution / Manila Electric Company v. Philippine Electricity Market Corporation et al, 10 March 2010
- 5.5. ERC Order, ERC Case No. 2008-083 MC, In Re: Petition for Dispute Resolution / Manila Electric Company v. Philippine Electricity Market Corporation et al, 7 March 2011.

## **6. RESPONSIBILITIES**

- 6.1. The Market Operator is responsible for calculating the line rental trading amounts in the WESM, segregated into cost of losses and congestion for each supplier-customer pair. The Market Operator is also responsible for providing trading participants with line rental trading amount information in accordance with the WESM Rules and the WESM Information Disclosure and Confidentiality Manual.
- 6.2. Parties to a bilateral contract transaction are responsible for the refund or collection of the line rental trading amount associated with transmission loss costs pursuant to the provisions of their bilateral contracts and the directives of the Commission.
- 6.3. This document is approved by the PEM Board in compliance with the directives of the Commission in ERC Case No. 2008-083 MC.

## **7. DETERMINATION OF LINE RENTAL TRADING AMOUNT**

- 7.1. Line rental trading amount is calculated as the difference between the value of the receiving node (customer) and the sending node (generator) or simply the difference between the customer Ex-Ante Nodal Price ( $EAP_L$ ) and the generator Ex-Ante Nodal Price ( $EAP_G$ ) multiplied by the bilateral contract quantity (BCQ) declared for that customer. The formula for the calculation of line rental trading amounts is as follows:

$$\text{Line rental trading amount} = \text{BCQ}_{G-L} (EAP_L - EAP_G)$$

Where:



BCQ <sub>G-L</sub>	-	BCQ declared by generator G in favor of customer L
EAP <sub>L</sub>	-	Ex-Ante Nodal Price of customer L
EAP <sub>G</sub>	-	Ex-Ante Nodal Price of generator G

- 7.2. The determination of the total trading amount of a customer, including its line rental trading amount, is presented as follows:

$$TTA_L = EAP_L (EAQ_L - BCQ_{G-L}) + EPP_L (MQ_L - EAQ_L) + BCQ_{G-L} (EAP_L - EAP_G)$$

Where:

EAP <sub>L</sub>	-	Ex-Ante Nodal Price of customer L
EAQ <sub>L</sub>	-	Ex-Ante Quantity of customer L
BCQ <sub>G-L</sub>	-	BCQ declared by generator G in favor of customer L
EPP <sub>L</sub>	-	Ex-Post Nodal Price of customer L
MQ <sub>L</sub>	-	Metered Quantity <sup>7</sup> of customer L
EAP <sub>G</sub>	-	Ex-Ante Nodal Price of generator G

- 7.3. The above formula is consistent with the WESM Rules, which provides that the aggregate trading amount of each participant with bilateral contracts equals the sum of:

- 7.1.1. The ex-ante energy trading amounts for each market trading node, i.e. EAP<sub>L</sub> (EAQ<sub>L</sub> - BCQ<sub>G-L</sub>); plus
- 7.1.2. The ex-post energy trading amounts for each market trading node, i.e. EPP<sub>L</sub> (MQ<sub>L</sub> - EAQ<sub>L</sub>); plus
- 7.1.3. The line rental trading amount corresponding to the quantity of bilateral contract of that trading participant, i.e. BCQ<sub>G-L</sub> (EAP<sub>L</sub> - EAP<sub>G</sub>).<sup>8</sup>

## 8. SEGREGATION OF LINE RENTAL TRADING AMOUNTS BY COMPONENT

- 8.1. Line rental trading amount attributable to losses may be segregated as follows:

$$\text{Line Rental}_{\text{Losses}} = BCQ_{G-L} * \text{Offer}_{MP} * TLF_{MP} \left( \frac{1}{TLF_L} - \frac{1}{TLF_G} \right)$$

Where:

Offer <sub>MP</sub>	-	Offer of Marginal Plant
TLF <sub>MP</sub>	-	Transmission Loss Factor of Marginal Plant
TLF <sub>L</sub>	-	Transmission Loss Factor of Load L

<sup>7</sup> As adjusted by the applicable site-specific loss factor

<sup>8</sup> WESM Rules, 3.13.17.2.

TLF<sub>G</sub> - Transmission Loss Factor of Generator G

In case of multiple marginal plants, Offer<sub>MP</sub> and TLF<sub>MP</sub> shall be based on the marginal plant reported by MMS.

If there is congestion, the difference, if any, between the LMP and the loss component of the respective LMPs of the parties to the bilateral transaction may be said to be attributable to congestion. The congestion cost component of line rental trading amount may thus be computed as follows:

$$\text{Line Rental}_{\text{Congestion}} = \text{BCQ}_{G-L} \left[ \left( \text{LMP}_L - \frac{\text{Offer}_{MP} * \text{TLF}_{MP}}{\text{TLF}_L} \right) - \left( \text{LMP}_G - \frac{\text{Offer}_{MP} * \text{TLF}_{MP}}{\text{TLF}_G} \right) \right]$$

Where:

LMP<sub>L</sub> - Locational Marginal Price of Load L

LMP<sub>G</sub> - Locational Marginal Price of Generator G

The derivation and details on the implementation of the above formula are in *Sec. 10 Appendix*.

## 9. PROCEDURE FOR PROVIDING LINE RENTAL TRADING AMOUNT INFORMATION

9.1. Line rental trading amounts segregated into the amounts attributable to the cost of losses and of congestion shall be calculated by the Market Operator and included in the billing statements of trading participants following the WESM billing and settlements timetable. Additional information to validate segregated line rental trading amounts may be provided by the Market Operator subject to the pertinent provisions of the WESM Rules and the WESM Information Disclosure and Confidentiality Manual.

## 10. APPENDIX

Formula on how to segregate the line rental trading amounts into amounts associated with the cost of losses and of congestion

$$\text{Line Rental} = \text{BCQ}_{G-L} (\text{LMP}_L - \text{LMP}_G)$$

$$\text{LMP}_L = \text{System Marginal Price} + \text{Losses} + \text{Congestion}$$

$$LMP_i = \lambda_i + \left( \frac{1}{TLF_i} - 1 \right) * \lambda_i + \sum_{j=1}^n \mu_{ij} a_{ij}$$

$$LMP_L = \frac{\lambda}{TLF_L} + \sum_{j=1}^n \mu_{ij-L} a_{ij-L}$$

$$LMP_G = \frac{\lambda}{TLF_G} + \sum_{j=1}^n \mu_{ij-G} a_{ij-G}$$

$$\text{Line Rental}_{\text{Losses}} = BCQ_{G-L} \left( \frac{\lambda}{TLF_L} - \frac{\lambda}{TLF_G} \right)$$

$$\text{Line Rental}_{\text{Congestion}} = BCQ_{G-L} \left( \sum_{j=1}^n \mu_{ij-L} a_{ij-L} - \sum_{j=1}^n \mu_{ij-G} a_{ij-G} \right)$$

or

$$\text{Line Rental}_{\text{Congestion}} = BCQ_{G-L} \left[ \left( LMP_L - \frac{\lambda}{TLF_L} \right) - \left( LMP_G - \frac{\lambda}{TLF_G} \right) \right]$$

$$\text{Line Rental}_{\text{Total}} = \text{Line Rental}_{\text{Losses}} + \text{Line Rental}_{\text{Congestion}}$$

Where:

$LMP_i$	-	Locational Marginal Price at location “i”
$\lambda$	-	The system marginal price based on marginal plant offer and transmission loss factor of the marginal plant
$TLF_i$	-	Transmission Loss Factor at location “i”. TLF are scaling factors applied on the nodal prices to account for the network loss associated with the delivery or with the consumption of energy at different locations in the system. TLF are dynamically computed within the Market Dispatch Optimization Model (MDOM) to fully account for the dynamic change in the losses due to a change in load at the various nodes.
$\mu_{ij}$	-	Price corresponding to transmission constraint between $i^{th}$ and $j^{th}$ node which is the price associated with the change of the schedules of the generators within the optimization process to prevent overloading a constrained transmission line or lines.
$a_{ij}$	-	Sensitivity factor relating the contribution of generation at location “i” to the energy flow related to constraint between $i^{th}$ and $j^{th}$ node

$n$  - The number of constraints involved that affects the node “i”

### Determining System Marginal Price

$$\lambda = \text{MCP} * \text{TLF}_{\text{MP}}$$

Where:

MCP - Market Clearing Price

### In Case that a constraint exist between Marginal Plant and Reference Bus

In implementing formula shown above, it is assumed that there are no line constraints between the marginal plant and the reference bus (swing bus), such that the system marginal price is computed using the market clearing price multiplied by the transmission loss factor of the marginal plant, thus:

$$\lambda = \text{MCP} * \text{TLF}_{\text{MP}} - \sum \mu^* a^* \text{TLF}_{\text{MP}}$$

MCP = Market Clearing Price

And:

$$\text{LMP}_i = \lambda_i + \left( \frac{1}{\text{TLF}_i} - 1 \right) * \lambda_i + \sum_{j=1}^n \mu_{ij} a_{ij}$$

Such that;

$$\begin{aligned} \text{LMP}_i = & \left( \text{MCP} * \text{TLF}_{\text{MP}} - \sum \mu_{\text{MP}a_{\text{MP}}} * \text{TLF}_{\text{MP}} \right) + \left( \frac{1}{\text{TLF}_i} - 1 \right) * \left( \text{MCP} * \text{TLF}_{\text{MP}} - \sum \mu_{\text{MP}a_{\text{MP}}} * \text{TLF}_{\text{MP}} \right) \\ & + \sum \mu_{ij} a_{ij} \end{aligned}$$

Simplifying the terms:

$$\begin{aligned} \text{LMP}_i = & \text{MCP} * \text{TLF}_{\text{MP}} - \sum \mu_{\text{MP}a_{\text{MP}}} * \text{TLF}_{\text{MP}} + \frac{1}{\text{TLF}_i} * \text{MCP} * \text{TLF}_{\text{MP}} - \text{MCP} * \text{TLF}_{\text{MP}} \\ & - \frac{1}{\text{TLF}_i} * \sum \mu_{\text{MP}a_{\text{MP}}} * \text{TLF}_{\text{MP}} + \sum \mu_{\text{MP}a_{\text{MP}}} * \text{TLF}_{\text{MP}} + \mu_{ij} a_{ij} \end{aligned}$$

$$LMP_i = \frac{1}{TLF_i} * MCP * TLF_{MP} - \frac{1}{TLF_i} * \sum \mu_{MP} a_{MP} * TLF_{MP} + \sum \mu_{ij} a_{ij}$$

$$LMP_i = \left( \frac{TLF_{MP}}{TLF_i} \right) * MCP - \frac{1}{TLF_i} * \sum \mu_{MP} a_{MP} * TLF_{MP} + \sum \mu_{ij} a_{ij}$$

Or;

$$LMP_i = TLF_{MP} * MCP + \left( \frac{1}{TLF_i} - 1 \right) * TLF_{MP} * MCP + \sum \mu_{ij} a_{ij} - \frac{1}{TLF_i} * \sum \mu_{MP} a_{MP} * TLF_{MP}$$

Relating to the equation for LMP as defined by WESM Rules:

LMP = System Marginal Price + Cost of Losses + Congestion Cost

$$\text{Line Rental}_{\text{Losses}} = BCQ_{G-L} \left( \frac{\text{Offer}_{MP} * TLF_{MP}}{TLF_L} - \frac{\text{Offer}_{MP} * TLF_{MP}}{TLF_G} \right)$$

$$\text{Line Rental}_{\text{Losses}} = BCQ_{G-L} * \text{Offer}_{MP} * TLF_{MP} \left( \frac{1}{TLF_L} - \frac{1}{TLF_G} \right)$$

$$\text{Line Rental}_{\text{Congestion}} = BCQ_{G-L} \left[ \left( \sum_{j=1}^n \mu_{ij-L} a_{ij-L} - \sum_{j=1}^n \mu_{ij-G} a_{ij-G} \right) + \sum \mu_{MP} a_{MP} * TLF_{MP} * \left( \frac{1}{TLF_G} - \frac{1}{TLF_L} \right) \right]$$

or

$$\text{Line Rental}_{\text{Congestion}} = BCQ_{G-L} \left[ \left( LMP_L - \frac{\text{Offer}_{MP} * TLF_{MP}}{TLF_L} \right) - \left( LMP_G - \frac{\text{Offer}_{MP} * TLF_{MP}}{TLF_G} \right) \right]$$

$$\text{Line Rental}_{\text{Total}} = \text{Line Rental}_{\text{Losses}} + \text{Line Rental}_{\text{Congestion}}$$