Republic of the Philippines
ENERGY REGULATORY COMMISSION
San Miguel Avenue, Pasig City

IN THE MATTER OF THE APPLICATION FOR THE APPROVAL OF THE PRICE DETERMINATION METHODOLOGY FOR THE PHILIPPINE WHOLESALE ELECTRICITY SPOT MARKET

ERC CASE NO. 2006-007 RC

DEPARTMENT OF ENERGY (DOE) THROUGH THE PHILIPPINE ELECTRICITY MARKET CORPORATION (PEMC)
Applicant.
x - x

DECISION

Before this Commission for resolution is the application, filed by the Department of Energy (DOE) through the Philippine Electricity Market Corporation (PEMC) on 22 February 2006, for the approval of the Price Determination Methodology (PDM) for the Philippine Wholesale Electricity Spot Market (WESM). For purposes of this Decision, any reference to PEMC as party to this application is to be taken to mean as a reference to the applicant DOE in whose behalf PEMC instituted the instant case.

SUMMARY OF PROCEEDINGS

On 14 March 2006, the Manila Electric Company (MERALCO) filed an *"Entry of Appearance"*.

Having found said application sufficient in form and substance and with the required fees having been paid, an Order and Notice of Public Hearing dated

24 February 2006 were issued setting the case for hearing on 28 March 2006. In the said Order, the PEMC was directed to submit its pre-trial brief.

The PEMC caused the publication of the Notice of Public Hearing, twice (2x) for two (2) successive weeks in two (2) newspapers of nationwide circulation in the Philippines, with the last day of publication made not later than fifteen (15) days before the date of the scheduled initial hearing.

The Office of the Solicitor General (OSG), the Commission on Audit (COA) and the Committees on Energy of both Houses of Congress were furnished with copies of the Order and the Notice of Public Hearing and were requested to have their respective duly authorized representatives present at the aforesaid initial hearing.

On 21 March 2006, the PEMC filed its *"Pre-Trial Brief"*.

On 24 March 2006, Puyat Jacinto and Santos filed its *"Formal Entry of Appearance"* as counsel for the applicant.

On even date, Atty. Jose T. Baldonado filed a motion praying that he be furnished with a copy of the application and annexes thereto and expressing his intention to participate in the instant application.

During the 28 March 2006 pre-trial conference hereof, the following entered their appearances:

1) Attys. Rachel Angela P. Anosan and Roy Santos for the Philippine Electricity Market Corporation (PEMC);

2) Engr. Robert Mallillin for the Napocor Industrial Consumers Association, Inc. (NICAI);

3) Atty. Jose T. Baldonado, an interested party;

4) Attys. Rommel Yap and Ronald Valles for the MERALCO;

5) Atty. Liberty Dumlao for the Power Sector Assets and Liabilities Corporation (PSALM); and

6) Mr. Pete Ilagan for the National Association for Electricity Consumers for Reforms (NASECORE).

At the said conference, the PEMC submitted proofs of compliance with the publication and posting requirements, which were duly marked as Exhibits "A" to "H", inclusive. Thereafter, the following submissions were made:

I. ISSUES:

A) For DOE/PEMC

a) Whether or not the Price Determination Methodology (PDM) as presented in the document termed as the Revised Price Determination Methodology Revision 23 January 2006 is compliant or consistent with the Wholesale Electricity Spot Market Rules (the WESM Rules), as amended, and with Republic Act No. 9136 (the

Electric Power Industry Reform Act of 2001 or EPIRA) and its Implementing Rules and Regulations (IRR)

B) For Atty. Jose T. Baldonado

a) Whether or not the application is sufficient in form and substance

b) Whether or not the publication of the application complies with the publication requirement of the EPIRA and its IRR

c) Whether or not the methodology as proposed is fair and reasonable

C) Intervenor MERALCO

a) Whether or not the PDM proposed by the DOE/PEMC is in accordance with the WESM Rules, the EPIRA and its IRR, and relevant laws, rules and regulations

The other parties presented no additional issues.

II. WITNESSES

A) For DOE/PEMC

a) Mr. Mario R. Pangilinan, Vice President for Market Operations of PEMC;

b) Mr. Robinson P. Descanzo, Department Head for Operations and Planning of PEMC;

c) Dr. Yen-Shong Chiao, PB Associates; and

d) Dr. John George, Auditor

The PEMC reserved the right to present additional witness/es as it deemed necessary in the course of the proceedings.

B) Intervenor MERALCO

Intervenor MERALCO reserved the right to present its witness/es as may be warranted in the course of the proceedings.

Further, NASECORE requested that the consumer groups be educated on technical matters related to the operation of the WESM in order for the consumers to be able to oppose or participate intelligently in the proceedings. Relative thereto, the Commission directed the PEMC to make a simplified presentation on the WESM and on the proposed PDM at an expository hearing set for such purpose.

In connection with the issue raised by Atty. Baldonado on whether the publication of the application complies with the publication requirement of the EPIRA and its IRR, considering the issue to be purely legal, the Commission directed the parties to submit their respective memoranda on the issue, after which the issue would be resolved.

Thereafter, the Commission set the following dates of hearing with the concurrence of all the parties: 1) 3 April 2006 for expository hearing; 2) 24-28

April 2006 for the presentation of PEMC's evidence; and 3) 8-11 May 2006 for the presentation of evidence, if any, of the intervenors / oppositors.

On even date, MERALCO filed its *"Pre-Trial Brief"*.

At the 3 April 2006 expository hearing hereof, the PEMC presented the salient features of the proposed PDM through a powerpoint presentation. In its presentation, it discussed how the WESM will operate and how the prices and dispatch schedules will be determined through the proposed PDM. During and after its presentation, clarificatory questions were raised by several of those present during the hearing, including the Commission, to which the PEMC responded. After the presentation, the Commission directed PEMC to submit the report on the independent audit of the Market Dispatch Optimization Model.

On the same date, the Commission received the letter dated 29 March 2006 of Engr. Siegfriedo A. Veloso of the Federation of Village Associations, Inc. requesting that he be furnished with all the documents already submitted to the Commission by PEMC in connection with the instant case.

On 7 April 2006, PSALM filed a *"Compliance and Manifestation"*. In the said pleading, PSALM commented on the application regarding the following: 1) gross pool concept; 2) benefits of nodal pricing over zonal pricing; 3) gaming opportunities in the ex-ante and ex-post market; 4) utilization of net-settlement surplus; and 5) procedures for the use of line rentals.

On 10 April 2006, the PEMC filed its *"Memorandum"* on the legal issue raised by Atty. Baldonado involving the sufficiency of the publication of the application. In the said memorandum, the PEMC argued that the publication of

the application alone is sufficient and in accordance with law. It further argued that what is critical, in determining whether or not publication of an application is in accordance with law, is the sufficiency of the information contained in the application that was published, i.e., whether or not the application as published sufficiently provides the readers with information to make them understand the subject matter being applied for as would enable them to determine its impact and to make comments on or challenge the same, if they so desire.

The PEMC submitted that the application, as published, already provides sufficient information on the matter applied for as would enable the readers to comment on the same and take such position or action as they deem appropriate, even without having to read the annexes thereof.

On 11 April 2006, the Commission received a letter dated 29 March 2006 from Dr. Bonifacio C. Dazo of the Federation of Las Piñas Village Association (FOLPVA) requesting that he be furnished with a copy of the application including its annexes.

On 17 April 2006, the following pleadings were filed: 1) PEMC's *"Compliance and Manifestation"* attaching therewith the Market Clearing Software Test Report dated 29 June 2005 and the Results from retesting of the ABB Market Software dated 05 December 2005; and 2) Atty. Baldonado's *"Memorandum (On the Application filed in this case)"*.

On even date, the Commission issued an Order directing the PEMC to furnish Atty. Baldonado a complete set of its application including its annexes.

At the 20 April 2006 hearing, the PEMC presented its first witness, Mr. Robinson P. Descanzo, Head of the Operations and Planning Department of PEMC. Mr. Descanzo testified on the following: 1) the principles and mathematical algorithm of the PDM; 2) the development of the PDM as having been approved by Philippine Electricity Market Board (PEM Board) and having gone through the required independent audit; and 3) that the principles and mathematical algorithm of the PDM are consistent with the elements approved in principle by the Commission and the WESM Rules. During his direct examination, Mr. Descanzo identified his Judicial Affidavit and affirmed the contents thereof, which constituted as his direct testimony. However, he made minor revisions on page ten (10) thereof, answer no. 47, to the effect that instead of "Section 6" as originally indicated, the same should have read "Section 3.6.1.3" and "Section 3.6.2." He also identified various documents referred to in his affidavit or in support of his testimony, which were presented and marked as Exhibits "I" to "U", inclusive, and their corresponding sub-markings.

After the termination of the direct examination of the witness, MERALCO, Atty. Baldonado and NICAI conducted their respective cross-examinations. The cross-examinations delved, among others, on the WESM Rules Change Committee, the documents included in the instant application pursuant to the directive of the Commission, the Market Network Model, the purpose of WESM, the objective of EPIRA and the amendments to the WESM Rules.

Thereafter, the Commission propounded clarificatory questions, among others, on the following: 1) gross pool and net pool concepts; 2) the need for a bilateral contract to be included in the bidding; and 3) the default value given for price takers in the PDM. Before the adjournment of the hearing, the PEMC manifested that the Commission take judicial notice of the proceedings had in the

previous PDM application, which it subsequently withdrew. The Commission directed the PEMC to submit in writing its motion for the Commission to take judicial notice of the previous application, indicating therein what specific portions of the records of the previous application it seeks to be taken notice of.

At the 24 April 2006 hearing, the PEMC presented its second witness, Mr. Mario Pangilinan, the Head of PEMC's Market Operations, who testified on the following: 1) the principles and procedures as contained in the mathematical formula or algorithm of the PDM; 2) the principles and procedures related to and pertinent to the PDM and its operation; 3) the PDM itself; 4) that its formulation and development by PEMC are consistent with the WESM Rules; and 4) other matters pertinent to the instant application. During his direct examination, Mr. Pangilinan identified his Judicial Affidavit and affirmed the contents thereof, which constituted as his direct testimony. He also identified various documents referred to in his affidavit or in support of his testimony, which were presented and marked as Exhibits "V" to "EE", inclusive, and their corresponding sub-markings.

After the termination of the direct examination of the witness, NICAI and Atty. Baldonado conducted their respective cross-examinations. The cross-examinations covered, among others, the manual of the settlement of must-run units, management procedure for load shedding, dispatch protocol, emergency procedure during overload, benefits of nodal pricing over zonal pricing, cross-subsidization, gross pool concept and how bilateral contracts would be treated under the gross pool, Market Management System (MMS), market power abuse, audit of the optimization model, the formula for deriving the locational marginal price for each node, and Marginal Transmission Loss Price and Marginal Congestion Price.

During the 25 April 2006 hearing, the Commission recalled PEMC's second witness, Mr. Pangilinan, and propounded clarificatory questions regarding the following: 1) Constraint Violation Coefficients; 2) Ancillary Services; 3) System Operator procedures for maintaining the balance within an hour; 4) basis for dispatch; 5) basis for calling in additional capacity to meet fluctuation within an hour; 6) the quantity of regulating reserves that the SO will maintain; 7) the time when the reserves will be contracted; 8) percentage of dispatchable reserve; 9) the impact on the ex-post price on the judgment of the SO as to how much or how little will be the reserves; 10) must-run units and how they are designated, when they are designated, who designates them, and how they are paid; 11) zonal and nodal pricing; and 12) the Default Dispatch Offer.

Subsequently, the PEMC presented its third witness, Mr. Yen-Shong Chiao, Chief Economist of PB Associates, who testified on the following: 1) his expertise in the field of regulation of energy markets and economics; 2) that he was engaged as an economist and regulatory expert for the WESM project and was directly involved in the review of the formulation of the Market Dispatch Optimization Model which embodied the PDM; 3) that the PDM will ensure maximum consumer benefits to the society and that the locational marginal pricing is an accepted standard model adopted by many foreign jurisdictions. During his direct examination, Dr. Chiao identified his Judicial Affidavit and affirmed the contents thereof, which constituted as his direct testimony. Said affidavit was marked as Exhibits "FF" and "FF-1".

After the termination of Dr. Chiao's direct examination, MERALCO, NICAI, Atty. Baldonado and PSALM conducted their respective cross-examinations. Their cross-examinations touched on the following subjects: pre-emptive market

power mitigation, particularly, on how market power can be mitigated, criteria to determine whether market conditions are ready for spot market, importance of contracting for energy, Financial Transmission Rights (FTRs), locational marginal pricing and cross-subsidization.

Thereafter, the Commission propounded clarificatory questions, among others, on the following: 1) co-optimization of energy and reserve requirements; 2) contingency reserve; 3) spot market trial; 4) pre-emptive market power mitigation measures; 5) the role of regulator in market rules change; 6) demand side participation; 7) marginal price; 8) gross pool and net pool; 9) zonal and nodal pricing; 10) bidding; 11) bid cap or price cap; and 12) Constraint Violation Coefficients.

At the 26 April 2006 hearing, the Commission recalled PEMC's third witness, Dr. Chiao, and propounded additional clarificatory questions, among others, regarding the following: 1) market power mitigation measures; 2) market governance and enforcement; 3) mitigation of risks for the consumers; 4) load forecasts; 5) load participation in terms of influencing the behavior of price; 6) the Market Network Model in connection with the MERALCO sub-system; and 7) procurement process for reserves.

Atty. Baldonado also cross-examined Dr. Chiao. During the cross-examination, further testimony was elicited of the witness on the matters he earlier testified on, particularly on the following: rules change process in the WESM Rules, pre-emptive market power mitigation measures, and the objective of the PDM.

Subsequently, the PEMC recalled its first witness, Mr. Descanzo, to answer additional clarificatory questions coming from the Commission.

At the 27 and 28 April 2006 hearings of the instant case, the PEMC presented its fourth witness, Dr. John A. George, of the PA Consulting Group, which conducted the independent audit under Dr. George's supervision of the Market Dispatch Optimization Model (MDOM) or the Philippine Wholesale Electricity Spot Market market-clearing software. In his testimony, Dr. George discussed at length the scope of the audit conducted, which included a mathematical formulation review, a software audit test and a retest program. The details of the tests and the testimony of Dr. George indicated some concerns that were not fully resolved by the retests conducted.

According to Dr. George, on several instances, the MDOM algorithm failed to converge using a 5-node test model. He likewise testified that the algorithm does not impose transmission line flow constraints to the level specified in the network model.

On 27 April 2006, the Commission also conducted a hearing at the PEMC office for the purpose of having a live simulation of the application of the MDOM taking into account several scenarios in the market.

On 28 April 2006, the PEMC filed its *"Memorandum"* praying that the Commission take judicial notice of its Order dated 15 March 2004 issued in its previous PDM application. In the said *Memorandum*, the PEMC likewise requested that judicial notice be taken of the document entitled *"Details and Status of Market Sustainability Measures"* attached as Annex B to the

Manifestation and Compliance filed by PEMC on 6 January 2006 in its previous PDM application.

On 3 May 2006, the Commission issued an Order directing the PEMC to conduct further validations on the software using the full system model or the Philippine Market Network Model to ascertain that the concerns posed by PA Consulting will not lead to significant inaccuracies in the locational marginal prices and dispatch quantities and to submit the results of the validation tests to the Commission within ten (10) days from receipt of said Order.

On 4 May 2006, the Commission issued a *"Pre-Trial Order"*.

On even date, the Commission issued an Order denying the request of PEMC to take judicial notice of the Commission's Order dated March 15, 2004 and the documents entitled *"Details and Status of Market Sustainability Measures"* attached as Annex B to the Manifestation and Compliance filed by PEMC in connection with its previous PDM application. The Commission also directed the PEMC to submit its proposed market sustainability measures, taking into consideration the testimony of its witness Dr. Chiao, with emphasis on the pre-emptive measures that it will undertake prior to commercial operations of the WESM.

On the same date, Atty. Baldonado filed his "*Response*".

During the 9 May 2006 hearing, the PEMC recalled its first witness, Mr. Descanzo, for further cross-examination by Atty. Baldonado and NICAI. At the said cross-examination, Mr. Descanzo gave further testimony regarding Market

Trading Nodes, the Market Network Model, gross pool, prices in different trading nodes, MMS, directly-connected customers, and wholesale aggregators.

On even date, the PEMC filed its *"Compliance"*.

At the 10 May 2006 hearing, after being directed by the Commission to present a witness from the System Operator, the PEMC presented Mr. Carlito C. Claudio, Vice President for Luzon System Operation of the National Transmission Corporation (TRANSCO), to the witness stand for questioning by the Commission. Mr. Claudio testified on the following: 1) real-time management; 2) must-run generators; 3) the parameters by which the System Operator calls in additional supply and the order by which it calls in additional plants; 4) compensation of must-run units; 5) system reliability; and 6) ancillary services. After the termination of the clarificatory questioning by the Commission, NICAI and Atty. Baldonado were allowed to ask their questions to Mr. Claudio.

Subsequently, the PEMC's second witness, Mr. Pangilinan, was recalled. In the course of the re-direct examination of Mr. Pangilinan, a document in support of the testimony of the witness was presented and marked as Exhibit "LL". NICAI and Atty. Baldonado posed further questions unto the witness and the Commission propounded additional clarificatory questions. After presenting Mr. Pangilinan, the PEMC manifested that it did not have additional witnesses to present and thus prayed that it be allowed to make its formal offer of evidence in writing, which the Commission granted. The other parties of record, except Atty. Baldonado, manifested that they are not submitting any evidence in support of their respective positions with respect to the application.

On 15 May 2006, the PEMC filed its *"Formal Offer of Evidence"* praying for the admission of Exhibits "A" to "LL", inclusive, and their corresponding sub-markings, for the purposes for which they are offered. On 26 May 2006, Atty. Baldonado filed his *"Comment on Formal Offer of Evidence"*.

On 05 June 2006, the Commission issued an Order admitting the PEMC's documentary exhibits for the purposes for which they are offered. In the same Order, the Commission directed Atty. Baldonado to manifest before the Commission his intention to present any witnesses or other evidences in support of his opposition to the application.

On 15 June 2006, the Commission received Atty. Baldonado's Manifestation indicating that he does not intend to present any evidence in this case.

DISCUSSION

The restructuring process in the EPIRA has brought, and will continue to bring about more changes in the electric industry geared towards a structure of free and fair competition. The establishment of a wholesale short-term market for electricity is a key pillar in the overall reform agenda. The Philippine WESM is a short-term market, which shall be the mechanism for setting the price of imbalance quantities transacted beyond bilateral contracts. It is a market for sellers and purchasers of electricity consisting of generators, distribution utilities, suppliers and bulk-consumers.

The applicant DOE is a government agency created and existing by virtue of Republic Act No. 7638. Under Section 30 of the EPIRA, the DOE is

mandated to establish the Philippine WESM; to formulate the rules for the WESM jointly with electric industry participants; and to establish the autonomous group market operator that will undertake the preparatory work and initial operation of the WESM. On 28 June 2002, with the joint endorsement of the electric power industry participants, the DOE issued Department Circular No. 2002-06-03 promulgating the WESM Rules, which is intended to govern the operations of the market.

On the other hand, PEMC, which was constituted as the autonomous group market operator, is a non-profit, non-stock corporation duly registered with the Securities and Exchange Commission on 18 November 2003. The primary purpose for which the PEMC is constituted under its Articles of Incorporation, is to manage, govern, and administer an efficient, competitive, transparent and reliable market for the wholesale purchase of electricity and ancillary services.

PEMC's Submission

The instant application is mainly founded on the Section 30, paragraph 2 of Republic Act No. 9136, otherwise known as the Electric Power Industry Reform Act of 2001 (EPIRA), which provides that:

> Jointly with the electric power industry participants, the DOE shall formulate the detailed rules for the wholesale electricity spot market. Said rules shall provide the mechanism for determining the price of electricity not covered by bilateral contracts between sellers and purchasers of electricity users. The price determination methodology contained in said rules shall be subject to the approval of the ERC. xxx

Pricing Principles

At the outset, the basic workings of the WESM are described hereunder for easier understanding of the pricing process. Pursuant to a central scheduling process set forth in the WESM Rules, all trading participants registered in the WESM are expected to submit their respective market offers or bids to the market. The generators must submit their respective price and quantity offers to the market operator, PEMC in this case, while the customers or the load may submit price and quantity bids. Customers are given the option to provide their respective forecasts to be used in the determination by the PEMC of market projections and real time schedule subject however, to a certain tolerance range set by the PEMC. Should the customer forecast be beyond the said tolerance level, PEMC forecasts shall be substituted for such. On the other hand, generators are to post their respective offers to the market for all the energy they intend to produce irrespective of their power supply contracts with their customers.

The PEMC then schedules all the available generation to meet the forecasted load or demand, taking into account the limitations and constraints of the transmission network to transport the energy from generators to customers and the limitations of the individual generating resources. The offers submitted by the generators are ranked from the lowest to the highest price offer. Generating facilities that are scheduled to run are stacked based on their price offers until the total generation matches the total load requirement for a particular trading interval.

The PEMC lays down various pricing principles embodied in its proposed price determination methodology, *viz*:

(a) Locational pricing is used to manage transmission congestion. The prices account for transmission losses and constraints that result from the operation of the electricity network.

(b) The ex-ante scheduling process or gross pool concept is adopted where each generator submits offers for both prices and the entire quantity of energy it is offering to produce for central scheduling and dispatch.

(c) The principle of self commitment is adopted whereby generators assume full responsibility for how and when their plants are operated whose bids must be accepted in the ex-ante market if these generation units are going to be scheduled to operate.

(d) A full nodal pricing regime for generation and customers is adopted. Nodal pricing is a mechanism for revealing, at different points in the system, the cost incurred to ensure sufficient power flows to meet all loads in all locations.

(e) Ex-post pricing is adopted in order to account for discrepancies between planned (ex-ante) and actual outcomes (ex post).

The WESM follows a gross pool concept where all energy is scheduled through the market. The trading participants are to submit their respective offers or bids to the PEMC, regardless of their existing power supply contracts. Even quantities covered by bilateral contracts are scheduled in the pool, as clarified by PEMC's witness, Mr. Descanzo in his testimony, thus:

HON. TAN:

> I just like to go, still on page 4 of your Affidavit and I'm directing you to Question 26 and your Answer 26. I'm talking about pricing principles. It's unfortunate that I was not here during the expository hearing, so, I am learning. So, you might have to be patient with me because I'm coming from ground zero. You talked about a gross pool concept. What is this gross pool concept all about?

MR. DESCANZO:

> This simply means that all the generators merchants and all those with bilateral contracts will be scheduled through the market and the basis for the scheduling is the quantity they offer with the corresponding price.

HON. TAN:

If there is a gross pool, is there also a net pool concept?

MR. DESCANZO:

I don't know, your Honor, if they call it net pool. But basically, it's on the issue of prioritizing some generators.

HON. TAN:

Are you familiar with that other concept?

MR. DESCANZO:

Not really, your Honor, but in other markets in US like PJM they have this concept market with balancing. So, before they do the labor time dispatch they commit or they come up with the schedule of all these generators with bilateral contracts. So, through the oasis system. So, what they are doing is actually managing the congestion because not all the generators with bilateral contracts can be accommodated for the schedule because of this limitation in the transmission system. So, they do a type of auctioning for the transmission use. And those bilateral generators that were scheduled or cleared during the process will be scheduled for the real time and only the balancing requirement is now to be addressed during the real time.

xxx xxx xxx

HON. TAN:

But, anyway, let me go back to gross pool. You said the gross pool is a situation wherein even bilateral contracts have to be bidded in. Is there also a concept wherein you do not anymore bid in the bilateral contracts?

MR. DESCANZO:

No, your Honor.

HON. TAN:

There is none.

MR. DESCANZO:

There is none, your Honor.

HON. TAN:

So, it is not possible wherein you only have a spot market net of bilateral contracts?

MR. DESCANZO:

No, your Honor, because the issue of the congestion management.

HON. TAN:

Please educate me why there is a need for a bilateral contract to be included in the bidding? Can you please educate me?

MR. DESCANZO:

I think there are two important issues why the bilateral contract or the generators with bilateral contracts should be scheduled. First is the issue on central scheduling, central dispatching concept. On that issue we or the system operator because he is the one who will implement the schedule is concern on how to manage the congestion. So, basically the decision on whether to prioritize the bilateral contracts, the generators with bilateral contracts over the merchant is not an issue to the system operator. The issue is confined or focused on the congestion management. So, on the issue of scheduling it is now the responsibility of market. So there should be unbiased method or decision for the market operator to implement. Basically, what we are saying now we don't give priority to whether they have contract. All you have to do is bid your quantity, corresponding price and we will schedule you on that basis. Is it a disadvantage to the bilateral contract orders? Actually, it's not a disadvantage to them because anyway they are covered with the contracts and if they are obligated to deliver, of course, they have this responsibility to deliver the contracts. Assuming they are not scheduled somebody from the rest of the generators will cover for their contracts which is if they are not scheduled the only meaning there is they have a higher price than the remaining generators."

[Transcript of Stenographic Notes (TSN) dated 20 April 2006, pp 97-103]

As explained, for every trading interval, which is set to one (1) interval hour, the PEMC is tasked to prepare the dispatch schedule consistent with such bids and offers submitted, as well considers the constraints in the transmission network and the limitations of the individual generating resources for the relevant trading interval. The bilateral power supply contracts are taken into account in the

settlement process developed by the PEMC in accordance with the provisions of the WESM Rules.

The prices in the WESM are determined using the marginal pricing concept and the economic principle of shadow pricing. The assumption is that in the bidding process, competition will force parties to offer at close or equivalent to their marginal cost of producing electricity. Theoretically, marginal cost pricing would occur when generators offer to supply electricity based on their marginal cost of production and the generator required to meet the demand requirements at a particular interval hour, known as the marginal generating unit, would set the market equilibrium price which all suppliers in the market receive. Yet, such is not the case in electricity markets. The adoption of the locational marginal pricing principle will not result in a price which is equivalent to the offer of the marginal generating unit since accounting has to be made of incremental transmission losses and capacity limits using the shadow pricing principle, as will be explained hereunder.

As mentioned, apart from the shadow pricing principle, the WESM adopts the locational marginal pricing concept whereby prices are expected to vary across the several locations in the power system, the price differences being attributed to transmission losses, as well as congestion occurring therein. The resulting prices in each location are referred to as the locational marginal prices and said concept is represented by the following formula:

$$LMP_i = \text{Marginal Generator Price} + \text{Marginal Transmission Loss Price} + \text{Marginal Congestion Price}$$

In mathematical form, the above is presented as follows:

$$LMPi = \lambda + \left[\left(\frac{1}{TLF_i} - 1\right) * \lambda\right] + \sum \mu_j a_{ij}$$

Where:

LMP_i = *Locational Marginal Price* at location "*i*"

λ = The system marginal price based on marginal plant offe·

TLF_i = *Transmission Loss Factor* at location "i" are scaling factors applied on the nodal prices to accou·nt for the network loss associated with the delivery or with the consumption of energy at different locations in the system.

u_j = Price corresponding to j^{th} transmission constraint which is the price associated with the change in the schedules of the generators within the optimization process to prevent overloading a constrained transmission line/s.

a_{ij} = Sensitivity factor relating the contribution of generation at location "*i*" to the energy flow related to constraint "*j*". This represents the amount of power flow change in a constrained line/s due to the change in the schedules of the generators to prevent overloading the constrained line/s.

The submission describes the three terms defined in the mathematical equation as follows:

a) The first term is the system marginal price which is the price set by the marginal plant scheduled in any trading period or interval.
b) The second term represents the change in the system marginal price due to losses and location.
c) The third term represents the change in the system marginal price due to transmission constraints. (Application, 22 February, p. 13)

1.1. For an unconstrained optimization, the u_j has a zero value, thus,

$$LMPi = \lambda + \left[\left(\frac{1}{TLF} - 1\right) * \lambda\right]$$

Simplifying further:

$$LMPi = \left[\frac{\lambda}{TLF_i} \right]$$

As an adjunct to said scheme, the PEMC proposes to adopt the full nodal pricing concept, that is, prices are determined both for the generators and customers in the WESM on a per node basis.

Aside from the full noda pricing concept, the WESM Rules allow for optional grouping by the customers into pricing zones, *viz*:

> Customer nodes may be grouped into customer pricing zones in accordance with the procedures to be developed by the Market Operator and subject to the approval of the PEM Board. The Market Operator shall maintain and publish the customer pricing zones to be used for the settlement of energy for customers". (Section 3.2.3.1, WESM Rules, as amended)
>
> All customers within a customer pricing zone shall face the same price for electricity consumed." (Section 3.2.3.2, WESM Rules, as amended)

A Customer Pricing Zone is a geographical area "within which all customers will face the same price for electricity consumed xxx." (WESM Rules, Glossary)

The WESM Rules also provides for the application of the concept of ex-ante and ex-post pricing which is defined as follows:

> **Ex-Ante Nodal Energy Price.** The price determined by the Market Operator for a particular market network node and trading interval, immediately prior to the commencement of that trading interval, directly from the dispatch optimization for that trading interval, in accordance with clause 3.10.2.
>
> **Ex-Post Nodal Energy Price.** The price determined by the Market Operator for a particular market node and trading interval, after the end of that trading interval in accordance with 3.10.6. (WESM Rules, Glossary)

Ex-ante prices are determined "prior to the event" and are based on forecasts by the PEMC as Market Operator whereas ex-post prices are determined on the basis of actual metered transaction data.

Utilizing the aforementioned concepts, a surplus or deficit will arise in the aggregate settlement transactions due to the application of loss factors and the line rental revenues from congestion in the transmission system. This generally happens when the prices at nodes where the load draws power are higher than the prices at the nodes where the generator injects power to the transmission network. In other words, this occurs when total payments by customers exceed the total payments to generators. In some circumstances (e.g. loop flows, forecasting error, etc.), the payments to generators exceed payments from customers, thereby resulting in a deficit in the net settlement. This surplus or deficit is defined in the WESM Rules as the net settlement surplus.

The Pricing Algorithm

The crux of this application is the mathematical algorithm contained in the Market Dispatch Optimization Model (MDOM). The MDOM is the market clearing algorithm that ultimately determines the nodal energy prices and dispatch schedule at all trading nodes of the system and at every trading interval. The nodal energy prices are the locational marginal prices used to compute charges and payments to the trading participants while the dispatch schedule is adhered to in dispatching the generators to meet the demand in the power system. It considers information on power system conditions and requirements from the System Operator taken in by the Market Network Model, as well as market offers and bids from market trading participants (i.e., generators or sellers and

customers). The MDOM utilizes linear programming as an optimization tool to arrive at a security constrained economic dispatch schedule.

Section 3.6.1.3 of the WESM Rules lay down the objective of the model as follows:

> The objective of the market dispatch optimization model shall be to maximize the value of dispatched load based on dispatch bids, minus:
>
> (a) The cost of dispatched generation based on dispatched offers;
>
> (b) The cost of dispatched reserves based on reserve contracted for or when applicable reserve offers; and
>
> (c) The cost of constraint violation based on the constraint violation coefficients.

The algorithm of the MDOM is expressed in the following mathematical formulation:

The objective function is to maximize the economic gain from trade where–

Economic Gain =

$$\left\{\sum_{i}^{E_D}\sum_{j}\left[\left(DB_{i,j}\right)\left(PDB_{i,j}\right)\right]-\sum_{i}^{E_G}\sum_{j}\left[\left(G_{i,j}\right)\left(PG_{i,j}\right)\right]-\sum_{i}^{E_R}\sum_{k}^{N_K}\sum_{j}\left[\left(R_{i,j,k}\right)\left(PR_{i,j,k}\right)\right]-\left(CVP\right)\right\}$$

i $\in$ resources (generators and dispatchable loads)
j $\in$ energy and reserve offer blocks
k $\in$ reserve types

Where:

$PDB_{i,j}$	The price per quantity element of the j^{th} Energy Bid block of the i^{th} Dispatchable Load.
$PG_{i,j}$	The price per quantity element of the j^{th} Energy Offer block of the i^{th} Generator (or dispatchable load).
$PR_{i,j,k}$	The price per quantity element of the j^{th} Reserve Offer block of the k^{th} Reserve Type of the i^{th} Resource.
Gi,j	The MW quantity of the jth Energy Offer block of the ith Generator (or dispatchable load).
Ri,j,k	The MW quantity of the jth Reserve Offer block of the kth Reserve Type of the ith Resource.
DBi,j	The MW quantity of the "jth" Energy Bid block of the ith Dispatchable Load.
CVP	The sum of penalty costs for soft constraints violations based on the constraint violation coefficients, where: $CVP = \sum_t [\ CVC_t * Q_t\ ]$ CVC_t = Constraint violation penalty cost for Constraint Violation Type "t" Q_t = Constraint violation quantity for Constraint Violation Type "t"
Ed	Total number of dispatchable loads with energy demand bids.
Eg	Total number of generators with energy offers.
Er	Total number of resources (generators or dispatchable load) with reserve offers.
Nk	Total number of reserve resources for each reserve type "k"

The WESM Rules require that the dispatch quantities for each trading interval are subject to the constraints laid down in Section 3.6.1.4 of the WESM Rules and described by the PEMC as follows:

a) Generator resource energy constraint
b) Reserve resource constraint
c) Reserve and energy constraint
d) Interruptible load reserve schedule
e) Nodal energy balance constraint
f) Area Reserve requirement constraint
g) Line flow constraint
h) System energy balance constraint
i) Regional energy import constraints
j) Regional energy export constraints
k) Regulation headroom constraint

The MDOM then processes information pertaining to the foregoing to come up with an optimum scheduling of energy and reserves that will maximize economic gains for the trading participants taking into consideration the physical limitations of the transmission network and of the facilities of the trading participants.

The PEMC submits that the MDOM is contained in a software that is developed specially for the WESM. It claims that this software was developed by the ABB, Inc., a third party contractor that was awarded the contract to develop the same through public bidding.

It is noted that the aforestated objective function takes into account penalty costs for soft constraints violations based on certain Constraint Violation Coefficients (CVCs). These are constraints that are considered in the MDOM which have corresponding penalty prices and apparently allowed to be violated to arrive at a feasible dispatch solution. If any of these CVCs are encountered by the MDOM, the associated CVC prices will be reflected in the nodal prices which, however, will not be used for the settlement of transactions in the WESM.

The following are the types of CVCs incorporated in the MDOM –

a) Deficit interruptible load reserve
b) Deficit dispatchable load reserve
c) Deficit regulating reserve
d) Deficit contingency reserve
e) Nodal Value of Lost Load
f) Contingency
g) Under generation/Over generation
h) Base Case constraint
i) Transmission Constraint Group (TCG)

Under Section 3.6.2 of the WESM Rules, the Market Operator is tasked to ensure , if these constraints are violated, that such violation occurs in appropriate priority order. Section 3.6.2 of the WESM Rules further states that:

> The constraint violation coefficient shall:
>
> (a) Be set so as to ensure that the market dispatch model will always find a solution which satisfies all constraints, if such a solution exists;
>
> (b) Be set so as to ensure that binding constraints are prioritized, such that constraints resulting in the lowest reduction in the capability of the network, load or generating units will occur first; and
>
> (c) Be set so as to ensure that the prices produced by the market optimization algorithm will be appropriate in all the circumstances taking into consideration the processes defined in Section 3.10 to adjust or override those prices for settlement purposes.

According to the PEMC, the resulting prices after considering these CVCs shall not be used for settlement. Rather, they are used only to give price signals to WESM participants to take corrective actions to address the constraints.

The Market Network Model is a significant input to the MDOM optimization process and it must represent the power system elements utilized for the determination of WESM dispatch schedules and prices as it provides information on the technical characteristics and limitations in the power system. Section 3.2.2.1 of the WESM Rules requires that the Market Network Model represent fairly the transmission network and the other aspects of the power system, thus:

> The market network model shall represent fairly, and in a manner which will facilitate consistent and reliable operation of the power system:
>
> (a) The transmission network under the control of the System Operator, and

(b) Such other aspects of the power system which, when connected, may be capable of materially affecting dispatch of scheduled generating units or pricing within the spot market.

The Market Network Model contains information on the technical characteristics of the transmission network, the connectivity, capacities and limitations of each network element. It also represents the node assignments and size of each generator and load. The Market Network Model also identifies the Market Trading Nodes on which the transactions for Trading Participants shall be referenced.

Section 3.2.2.1 of the WESM Rules requires the PEMC as Market Operator to maintain and publish the Market Network Model. As part of its submission, the PEMC presented the WESM Market Network Model (Exhibit "O"), which is developed in consultation with electric power industry participants and approved by the Philippine Electricity Market Board (PEM Board); the WESM Market Network Model Manual (Exhibit "M"), containing the parameters used in the development of the Market Network Model; and the Single Line Diagram Market Network Model for the Luzon grid (Exhibit "N"), initially determined for the WESM commercial operation in Luzon.

According to the PEMC, the Market Network Model was developed by the PEMC utilizing the Energy Management System of the System Operator, a network model that represents the entire bulk power system. The network parameters used in developing the Market Network Model, including line and equipment capacity, resistance, reactance and admittance, are taken from the load flow model of the power system.