

//MDOM Certificate 30 Sept.doc

30 September 2011

Ms Melinda L. Ocampo
President
Philippine Electricity Market Corporation
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ADB Avenue, Ortigas Center,
Pasig City
Republic of the Philippines

Certification of the Market Dispatch Optimization Model Software

Dear Ms Ocampo,

As a result of our examination of the WESM Rules and of the MDOM software, we are able to provide the following certification with respect to the MDOM software:

We certify that the MDOM software provided by by ABB through MA version release MA1.5.12 will perform substantially in compliance with the software specifications implied by WESM Rules dated 28 June 2002, as amended, together with the associated Market Manuals, System Operating Procedures and Market Formulation.

Although we have observed and noted some aberrations or anomalies in relation to the software specifications, we believe that they are not likely, of themselves, to represent a material deviation from the design concept contained in WESM Rules provided due attention is paid to the points noted in this Certification in the use of the software.

Scope of the review and certification

The scope of the audit has included, at a minimum,

1. Examination of the algorithms used in the MDOM software to determine if the algorithms are mathematically equivalent to the formulation described in the WESM Rules;
2. Tests to determine whether the outputs of the MDOM software are consistent with those which result from the application of the formulation described in the WESM Rules; and
3. Identification of inconsistencies and non-compliance of the MDOM software with the WESM Rules.

The independent audit does not include ensuring that the computational performance of the software is in accordance with any requirements of the Market Rules.

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Nature of the tests conducted and results obtained

In performing the review and certification of the MDOM software, we have:

- Examined the MDOM and WESM Rules documents to fully understand what functions the software is required to perform, what data the software is required to use, what results the software is required to produce, and how it is to calculate them; and then
- Conducted a series of tests on the software to determine whether the software properly performs these functions and correctly calculates the results required. In this respect, the software was tested for its accuracy in representing the requirements of WESM Rules

Provided the MDOM software is used in the manner intended and with data that conforms to the requirements specified in the PEMC documents or, if not explicitly discussed therein, is within the expected range of values for data pertaining to the characteristics of the Philippine electricity system, we have found that the MDOM software performs all functions and correctly calculates the required results with the following exceptions

- *Violation of HVDC limits is not possible.* HVDC line flow limits are set by imposing a Security Limit. It is our understanding that security limits cannot be violated in MDOM and therefore the violation variables specified in the formulation for TCG constraints are effectively not present in MDOM. This means that a TCG violation is not possible and other violations will occur instead.
- *Incorrect reserve prices reported.* Reserve prices reported for some tests were incorrect and reflected only the energy-related cost and not the reserve offer cost. In other tests reserve prices were correct and reflected both. The erroneous reporting of the reserve prices does not affect the current operation of the market.
- *Undocumented combined ramping constraint in MDOM.* Contrary to the previous external audit finding that there is no combined ramping constraint on the dispatch of energy and reserves together, PA has found that such a constraint does exist. These constraints are not specified in the formulation and are implemented in the software in an undesirable manner. Further, the ramp time allowed by these constraints is inconsistent with the setting of generator initial MW.
- *CVC values are not ideal.* Constraint Violation Coefficient (CVC) prices currently used in MDOM are those that were originally set with the intention that they be used only until more representative prices could be determined, and could easily be improved upon.
- *Line flow limits:* The solution algorithm does not appear to allow a dispatch schedule that exactly meets a transmission line flow limit. Instead, the calculated line flow will tend towards the limit but can undershoot it by a noticeable amount – possibly by 0.75% . This appears to be a feature of the specific solution methodology used. Although the dispatch schedule will be marginally wrong we expect that to be of only a minimal practical significance, other than when there are binding flows on large capacity transmission lines in which case there may be an error in the dispatch schedule and LMPs of commercial significance.

Disclaimer of Liability

PA Consulting Group (PA) has been asked by the Philippine Electricity Market Commission (PEMC) to act as an independent market auditor to perform extensive testing of the market dispatch optimization model (MDOM) to verify its compliance with the WESM Rules

Despite the extensive testing of the software, this certification is not, and cannot be, in the form of an absolute guarantee. Error-free use and compliant results through time will increase the probability that the software is in strict accordance with the design principles.

Further, our certification is only valid if the software is used with care and for the purpose for which it was designed and tested.

In furnishing this certification, PA specifically limits its liability to the cost of repeating all and any certification evaluations, and any necessary re-certification in reliance on those evaluations. No person shall be entitled to claim against PA, any losses or damage whether direct, indirect, special or consequential, in excess of that limitation. PEMC shall ensure that all persons or parties who may rely on this certification are aware of this limitation of liability.

Yours sincerely

A handwritten signature in black ink, appearing to read "Gregg Edeson", with a stylized, cursive script.

Gregg Edeson
Member of PA's Management Committee

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