PA Consulting Group

123 Buckingham Palace Road
London SW1W 9SR
UK

Tel: +44 20 7730 9000
Fax: +44 20 7333 5050
        www.paconsulting.com

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Melinda L. Ocampo
President
Philippine Electricity Market Corporation
9th & 18th Floors, Robinson's Equitable Tower
ADB Avenue, Ortigas Center
Pasig City 1600
Republic of the Philippines

Dear Ms Ocampo

Certification of the Market Dispatch Optimization Model Software

PA Consulting Group (PA) has been asked by the Philippine Electricity Market Corporation (PEMC) to act as an independent market auditor to perform certification testing of the Market Dispatch Optimization Model (MDOM) software to verify its compliance with the WESM Rules. This certificate is similar to and builds on the previous certificate for the MDOM software, dated September 30, 2011.

Certification

This certification is specific to the Security Constrained Economic Dispatch (SCED) component of the Market Applications (MA) subsystem of the Market Management System (MMS). The SCED is the software that implements the MDOM based on clause 3.6 of the WESM Rules and on the mathematical formulation specified in the Price Determination Methodology (PDM) WESM Manual.

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

> *We certify that the SCED software, provided by ABB as part of the MMS and updated to include patch MA1.5.12, will perform substantially in compliance with the software specifications implied by the WESM Rules as amended by Department of Energy (DOE) Department Circulars up to and including DC2011-12-0012, together with the WESM Manual, "Price Determination Methodology for the Philippine Wholesale Electricity Spot Market".*

> *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 the 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 review has included, at a minimum:

1. Examination of the algorithms specified in the PDM 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 SCED 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 SCED 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 WESM Rules.

Nature of the tests conducted and results obtained

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

• Examined the WESM Rules, the PDM Manual and MMS documents to fully understand what functions the software is required to perform, what data it is required to use, what results the software is required to produce, and how it is to calculate them; and

• 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 SCED 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 SCED 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. Security Limits cannot be violated in the SCED software and therefore the violation variables specified in the formulation for Transmission Constraint Group (TCG) constraints are effectively not present. This means that a TCG violation is not possible and other violations will occur instead.

• *Erratic nodal prices in heavy congestion.* Erratic prices were observed in Visayas in one test case involving heavy congestion. Visayas nodes reported non-zero sensitivity factors in relation to a constraint in Luzon, despite the HVDC limit binding in the Visayas-to-Luzon direction, which should isolate Visayas nodes from the constraint in Luzon.

• *Forced dispatch of Pmin generation.* The forced dispatch of generators to their minimum stable operating limit, or Pmin, is implemented as specified in the PDM but is arguably in conflict with clause 3.6.1.5(c) of the WESM Rules.

- *Undocumented combined ramping constraints.* 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

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

Gregg Edeson
Member of PA's Management Group