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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 Wholesale Electricity Spot Market (WESM) Rules. This certificate is similar to and builds on the previous certificates for the MDOM software dated 30 September 2011, and 7 November 2012.

### **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) Market 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 MA1.5.13, will perform substantially in compliance with the WESM Rules as amended by Department of Energy (DOE) Department Circulars up to and including DC2012-02-0011, 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.*

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## 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, 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:

- *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.

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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.

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 blue ink, appearing to read 'S Thornton', with a stylized flourish at the end.

Steve Thornton  
Member of PA's Management Group