

**Report on the
Independent Operational Audit of the Systems
and Procedures on Market Operations**
for the period 26 June 2011 to 25 June 2012
by PA Consulting Services Ltd.
(AP 2012-02)

PEM Audit Committee

February 2013

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Executive Summary

This report provides the objectives, scope and results of the Independent Operational Audit of the Systems and Procedures on Market Operations (3rd MO Audit) covering the period 26 June 2011 to 25 June 2012 (AP2012-02) conducted by PA Consulting Services Ltd. (PA) of New Zealand.

Following the approval of the PEM Board on 11 October 2011, the PA was reappointed as the External Auditor for the 3rd MO Audit.

As provided in the Statement of Work, the project covers the audit of the systems and procedures on market operations, and the billing and settlement, including the interfaces with the SO, MSP, Trading Participants, Energy Regulatory Commission (ERC) and the Department of Energy (DOE) The project also included the audit of the Market Assessment System (MAS) and any procedures and working processes used in the collection, validation and processing of market monitoring data, and calculation of monitoring indices.

The Project seeks to accomplish the following:

- a. Conduct of more efficient and expeditious yearly market audit, as required under the Wholesale Electricity Spot Market (WESM) Rules and the PEM Audit Market Manual (Manual);
- b. Continuity in the market operations audit process and timely follow-up on Client's actions to address audit findings and recommendations;
- c. Conduct of software and special audits, as soon as necessary; and
- d. Provision of real time support requirements of the PEM Audit Committee (PAC), PAC Technical Working Group (TWG) and the Client.

PA reported to the PAC for the duration of the audit, which commenced on 09 July 2012. As identified by PA, the audit was conducted according to the following areas:

1. **Market Software Testing** covered the compliance and accuracy of key algorithms and calculations within the suite of market software;
2. **Operational Procedure Review** assessed whether the Market Operator and the Market Assessment manuals and procedures are aligned with WESM Rules and meet best practice standards as assessed by the PA procedure evaluation framework;
3. **Operational Process Review** assessed whether selected Market Operator and Market Assessment processes are in compliance with the WESM Rules and consistent with best practice standards defined by the PA process evaluation framework; and
4. **IT Systems Review** provided an assessment against international best practice standards with respect to software management, operations and security. It also provided software validation for selected interfaces and systems beyond those included in the Market Software Testing.

As part of the audit process, PA discussed issues relating to the market operation's conformance with the WESM Rules, WESM Manuals and applicable policies and regulations with the auditees, PAC/TWG and PEMC management prior to and during the finalization of the Final Audit Report.

In response to PA's audit findings and recommendations, PEMC furnished PA with Responses, which were duly incorporated in PA's final audit reports.

PEMC is currently formulating a detailed Action Plan to address PA's findings and recommendations, which will be integrated with the pending items from the PEMC's Action Plan from the first and second market operations audits.

In accordance with its mandate under the WESM Rules, the PAC fully accepts the findings and recommendations of PA as provided in the following documents dated 12 December 2012:

1. Market Audit Summary Report;
2. Certification of the Market Dispatch Optimization Model Software;
3. Certification of the Market Settlements Software; and
4. Internal reports.

As provided for under the PEM Audit Manual, the PAC will monitor the MO's compliance to the Action Plan, through an assessment of the development and implementation of the audit recommendations.

I. About this Report

In compliance with Section 3.7.2¹ of the PEM Audit Market Manual ("Manual"), this report provides the objectives, scope and results of the Independent Operational Audit of the Systems and Procedures on Market Operations covering the period 26 June 2011 to 25 June 2012 (AP2012-02).

II. Background

Under the WESM Rules, the PEM Board established the PEM Audit Committee (PAC), which is mandated, on its own or through appointment of external auditors, to conduct, coordinate and supervise audits of the operations of the spot market and of the MO to reinforce Trading Participants' confidence in the transparency and adequacy of the operation of the Wholesale Electricity Spot Market (WESM).²

In line with this mandate and under the supervision of the Department of Energy (DOE), the PAC administers independent operational audits of the systems and procedures on market operations through external auditors.

The first market operations audit, for the period 26 June 2007 to 25 June 2009, was conducted in 2009 (AP2009-01) by Deloitte Touche Tohmatsu of Australia, in cooperation with the Intelligent Energy Systems (IES) and Manabat Delgado and Amper (Deloitte Philippines). The second market operations audit for the period 26 June 2009 to 25 June 2011 was conducted by PA Consulting Group Ltd. (PA) of New Zealand. PA also conducted the recently concluded market operations audit for the period 26 June 2011 to 25 June 2012.

III. Audit Objectives

The general objectives of the Audit Project³ as required under the PEM Audit Market Manual, are consistent with those of the 1st and 2nd Independent Operational Audit of the Systems and Procedures on Market Operations, as follows:

1. Review and assess the procedures and working processes of the Market Operator (MO);
2. Review and assess the usefulness and appropriateness of systems settlement system, data management and other procedures and working processes used by the MO to administer the WESM, in order to:
 - a. identify the appropriate steps and measures to help the MO effectively and efficiently perform its responsibilities in time and form in accordance with the WESM Rules;

¹ Within fifteen (15) days after an audit is finalized by the PEM Auditor or by a designated expert or expert team contracted to act as auditor(s), the PEM Auditor shall prepare and submit to the PEM Board an Audit Report which specifies details of the said report.

² WESM Rules, Clause 1.5 and PEM Audit Market Manual, Section 3.1

³ PEM Audit Market Manual, Section 7.2.2

- b. assess if the MO practices and work processes ensure the necessary transparency, independence, predictability and non-discrimination, and are in compliance with the WESM Rules and best international practices; and
 - c. assess if the systems, calculations, information flows and data management protect the accuracy and quality of the data and results in generation scheduling, dispatch, prices and settlement, as well as evaluate if internal controls exist and are sufficient to guarantee security and confidentiality where appropriate; and to propose recommendations to improve the: (1) procedures to collect and process the information and, (2) controls of quality and security of data in the WESM.
3. Review and assess the usefulness and appropriateness of the interfaces and exchange of information among the MO, System Operator (SO), Metering Service Provider (MSP) and other service providers in relation to generation scheduling, constraints, dispatch, prices and settlement, and metering;
4. Review and assess the compliance by the MO with the WESM Rules and WESM Manuals;
5. Review and assess the effectiveness of the Market Assessment System (MAS); and
6. Certify that the following are adequate and in full compliance with the Market Rules: any new software or associated systems, or modified existing software or their associated systems for generation, scheduling, dispatch or settlement or price calculation relevant to the WESM.

IV. Audit Scope

The Audit Project covered and reviewed the MO's compliance with its procedures and the effectiveness and appropriateness of systems utilized in the operation of the spot market, which included but were not limited to:

1. Valid audit certificates for the current versions of all numeric software;
2. The calculations and allocations performed by the metering and settlements systems;
3. Billing and information systems;
4. The scheduling and dispatch processes;
5. The processes for software management; and
6. The MO's compliance with the WESM Rules.⁴

The Audit Project covered the market operations and transactions from 26 June 2011 to 25 June 2012. Its coverage is shown in Figure 1.

⁴ PEM Audit Market Manual, Section 5.2.6.2

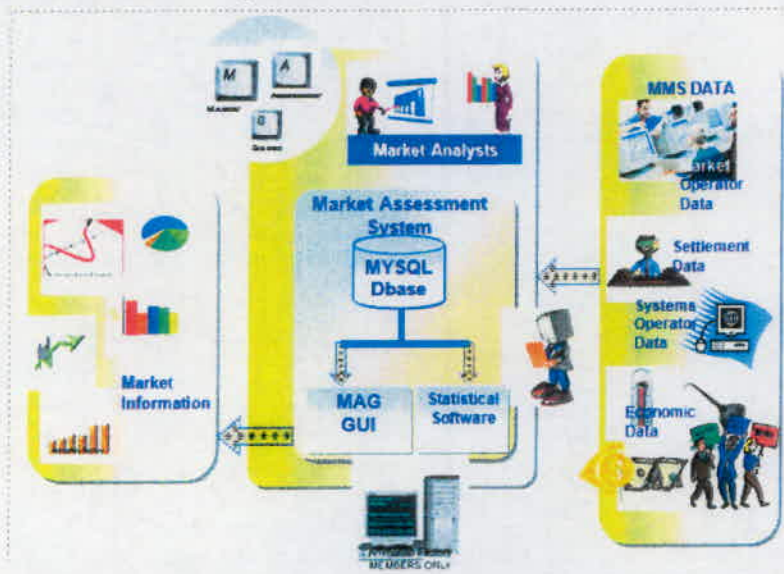
Figure 1. WESM Operations



Notes: MMS – Market Management System

In addition, the audit covered the review of the Market Assessment System (MAS) and any procedures and working processes used in the collection, validation and processing of market monitoring data, and calculation of monitoring indices, as shown in Figure 2.

Figure 2. Market Assessment System



Notes: GUI – Graphical User Interface

In addition to the above, PA focused on the key changes and developments made by PEMC on its internal procedures, processes and systems since the 2011 MO Audit.

V. External Auditor Selection Process

PA was retained as the External Auditor for the 3rd MO Audit based on its satisfactory work during the 2nd MO Audit. Its retention has been recommended by the PAC and thereafter approved by the PEM Board on 11 October 2011.

PA is an international management, systems and technology consulting company operating worldwide in some 20 countries. PA has its Corporate Headquarters at 123 Buckingham Palace Road, London, SW1W 9SR, United Kingdom and has now been in business for over sixty years, having been established during World War II to optimize production of the Hurricane fighter. PA has been involved in auditing and certifying market operations and settlement software for a wide range of clients in varying geographies including the New York ISO, ISO New England, Ontario IESO, Transpower New Zealand, West Australia IMO and the California Power Exchange. PA was the certifying auditor of the WESM MMS in 2006.

VI. Audit Implementation

The External Auditor reported to the PAC for the duration of the audit, which commenced on 09 July 2012. The audit service contract (Contract) was signed by the PEMC President Melinda Ocampo and PA Director Stephen Thornton in counterparty.

All audit activities were coordinated by the PAC, through the MAG which served as the linkage for PA to PEMC and other relevant parties.⁵

As identified by PA, the audit was conducted according to the following areas:

1. **Market Software Testing** covered the compliance and accuracy of key algorithms and calculations within the suite of market software. Software testing focused on mathematical accuracy and appropriateness, and on compliance of the implementation with the WESM Rules and Manuals.
2. **Operational Procedure Review** assessed whether the Market Operator and the Market Assessment manuals and procedures are aligned with WESM Rules and meet best practice standards as assessed by the PA procedure evaluation framework. Procedures were reviewed and scored against six criteria (i.e. compliance, context, process, timeline, accountability and governance) and allocated a summary Red-Amber-Green (RAG) score that indicated how well each procedure performed overall (i.e. Red-will not ensure compliance; Amber-may ensure compliance; Green-should ensure compliance).
3. **Operational Process Review** assessed whether selected Market Operator and Market Assessment processes are in compliance with the WESM Rules; and consistent with best practice standards defined by the PA process evaluation framework. PA adopted a four stage approach as follows:
 - a. Short-listed the Market Operations, Settlement and Market Assessment processes to audit based on risk and materiality;
 - b. For the short-listed processes:

⁵ The MAG provides technical and administrative support to the PAC in accordance with WESM Rule 1.4.7.1.

- i. Identified Rules obligations to be tested for compliance based on risk and materiality; and
 - ii. Identified controls and measures to be used to determine non-compliance against the Rules.
 - c. Having developed the control measures to be used to test compliance, undertook the compliance review by analysing PEMC data and interviewing relevant teams; and
 - d. PA assessed the short-listed processes for compliance risk, by reviewing each process against process management, process scale and complexity, resourcing and the results of the compliance review.
4. **IT Systems Review** provided an assessment against international best practice standards with respect to software management, operations and security. It also provided software validation for selected interfaces and systems beyond those included in the Market Software Testing. The review included an assessment of both PEMC's policies and practices including a verification of current practice against recommendations made in the previous audit. The international best practice standards considered included ISO 27001 and ISO 27002 for IT security, TIA-942 for Data centre infrastructure), BS 25999 (for BCP/DR), and ITIL v3 (for IT Service Management).

In accordance with the Contract, PA submitted reports on schedule, as follows:

Deliverables	Target Date	Status
Inception Report	27 July 2012	Completed
1 st Progress Report	10 August 2012	Completed
Draft Audit Reports	07 September 2012	Completed
2 nd Progress Report	26 September 2012	Completed
Last Progress Report	11 October 2012	Completed
Final Audit Reports and Software Certificates	09 November 2012 and 12 December 2012	Completed

Further, PA discussed issues relating to the market operation's conformance with the WESM Rules, WESM Manuals and applicable policies and regulations have been discussed in multiple meetings with the auditees, PAC/TWG and PEMC management prior and during the finalization of the Final Audit Report.

A summary of the audit activities and timeline is provided in Attachment B.

VII. Summary of Audit Results

Considering that this is the 3rd MO Audit, the PA focused on key changes and developments since the 2011 audit. PA reiterated some of its findings and recommendations in its previous audit and raised additional recommendations in the 3rd MO Audit.

The table below provides the statistical summary of findings PA have found per audit area.

Area of Review	Number of Findings
Market Software Testing	36
IT Systems Review	40
Process and Compliance Review	20
Procedure Review (Priority)	11
Total	107

Further, PA highlighted in its report the following areas which need to be addressed in a timely manner and be given high priority and importance:

1. Calculation of settlements - this is currently performed in spreadsheet programs and a new system will not be in place for some time. The use of Excel/VBA tools for this task is not appropriate by international best practice standards and the tools are error-prone and not user-friendly. This audit recommends improvements that can be made to the spreadsheet programs to mitigate the risk of errors while they continue to be used.
2. Prudential Requirements - these continue to cause significant problems for PEMC as some trading participants fail to meet their payment obligations. While this issue is wider than just the Market Operator and there are measures being undertaken by various parties, there are also additional actions that PEMC can take to mitigate some of the issues faced as MO, improve PEMC's compliance with the WESM Rules, and incentivise compliance by trading participants.
3. Market design review - a number of design aspects of the WESM have been raised by PEMC and participants, or have been noted by PA, that appear to be problematic or could be improved. Most of these areas do not conflict with the WESM Rules and so are not within the scope of this audit. Nevertheless, attention to these areas could significantly improve the operation and utilisation of the spot market. We note that PEMC plans to tender for an external advisor to conduct a broad market design review. This study will relate closely to the replacement of the Market Management System (MMS) and is critical in defining the requirements of that system.

The PA Audit Summary Report and software certificates are provided in Attachment C.

VIII. Auditee Response and Actions Taken

In response to PA's audit findings and recommendations, PEMC furnished PA with Responses, which were duly incorporated in PA's final audit reports.

In relation to the said Responses, PEMC is currently formulating a detailed Action Plan to address PA's findings and recommendations. Said Action Plan will be integrated with the pending items from the PEMC's Action Plan from the first and second market operations audits.

IX. Conclusion

The PAC fully accepts the findings and recommendations of PA as provided in the following documents:

A. Software Certificates submitted on 09 November 2012, as follows:

1. Certification of the Market Dispatch Optimization Model Software; and
2. Certification of the Market Settlements Software.

B. Final Audit Reports submitted on 12 December 2012, as follows:

1. Public Report;
2. Internal Reports.

X. Next Steps

In view of the Audit Project results, the PAC will monitor the MO's compliance to the Action Plan, through an assessment of the development and implementation of the audit recommendations.

XI. Endorsement to the PEM Board


Prepared and Submitted By:
PEM AUDIT COMMITTEE



Felixberto U. Bustos, Jr.
Chairperson / PEM Auditor

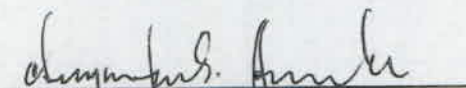


Eduardo Alejandro O. Santos
Member



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Member

Certified By:
PAC SECRETARIAT



Chrysanthus S. Heruela
Vice President, Market Assessment Group

Attachment A: Pre-Audit Activities

Date	Activity
06-Oct-11	Approval of PAC/TWG to recommend the negotiation of a 3-year contract with PA to the PEMC Board
11-Oct-11	PEM Board approval of the reappointment of PA as the External Auditor
03-Nov-11	PAC, TWG, PEMC and PA Coordination Meeting
09-Dec-11	PEMC and PAC Meeting with PA to discuss the Audit Scope and Cost
26-Jan-12	Transmittal of Statement of Work and Framework Agreement to PA
01-Feb-12	Transmittal of PA's comments on the Statement of Work and Framework Agreement
08-10 Feb-12	PEMC negotiation meetings with PA to finalize the Statement of Work and Framework Agreement
10-Feb-12	PA agreed to conduct a one year audit of the market operations for 2011-2012
28-Feb-12	Submission of the revised Statement of Work and Framework Agreement by PEMC
05-Mar-12	Approval of Statement of Work and Framework Agreement by PA
12-Mar-12	Contract Date
23-Mar-12	Receipt three sets of the signed, consularized and notarized Statement of Work and Framework Agreement from PA via courier
12-Apr-12	President Ocampo signed Statement of Work and Framework Agreement Transmittal of the signed documents to PA via courier
23-Apr-12	PA received the signed and notarized Statement of Work and Framework Agreement

Attachment B: Audit Implementation – Timeline/Activities

Date	Activity
09-July-12	Commencement of the Review
18-July-12	Submission of the draft Inception Report by PA
20-July-12	PA requested novation of Framework Agreement from PA Consulting Group to PA Consulting Services
23-July-12	PAC/TWG Meeting with PA on the Inception Report
26-July-12	Approval of the novation of Framework Agreement from PA Consulting Group to PA Consulting Services by the PEM Board
27-July-12	PA submission of the final Inception Report
31-July-12	President Ocampo signed the novation of the Framework Agreement from PA Consulting Group to PA Consulting Services
10 -Aug- 12	PA submission of the 1st Progress Report
17-Aug- 12	Approval of the inception report by the PAC/TWG
26-Aug-12	PAC/TWG and PEMC Meeting with PA regarding the 1st Progress Report
	PA submitted a memo to PEMC and PAC regarding Periods for prudential requirements in wholesale electricity markets
07-Sept-12	Submission of the draft audit reports by PA
07-Sept-12	Transmittal of Memo requesting PEMC Department's comments on the Draft Audit Reports
25-Sept-12	Transmittal of PEMC's comments and responses on the draft audit reports
25-Sept-12	PAC/TWG meeting with PA for the draft audit reports
	Submission of the 2nd Progress Report by PA
01-Oct-12	Approval of release of 1st Payment (USD 50,000) by President Ocampo
09-Oct-12	Submission of PA's response/feedback on PEMC's comments
11-Oct-12	Submission of the last progress report by PA
16-Oct-12	PA submitted the BIR-approved Tax Treaty Relief Application Form
24-Oct-12	PAC/TWG approval of the 2nd and last progress reports
23-Oct-12	Remittance of 1st Payment amounting to USD 50,000
09-Nov-12	Submission of the software certificates and final audit reports by PA
14-Nov-12	Approval of release of 2nd and 3rd Payments (USD 62,500 each) by President Ocampo
23-Nov-12	Remittance of 2nd Payment and 3rd Payment amounting to USD 62,500 each
14-Nov-12	PA submitted to PEMC and PAC the following memos a. Future Audit Scope Considerations- this memo discusses software systems used in WESM operations, for consideration in the scope of work for future audits; and b. 2012 Operational Audit IT Review Additional Material
23-Nov-12	Transmittal of PEMC's additional comments on the final audit reports
12-Dec-12	Submission of the revised Final Audit Reports by PA
13-Dec-12	PAC/TWG Approval of the Final Audit Reports and Software Certificates
27-Dec-12	Approval of release of Last Payment (USD 75,000) by President Ocampo
07-Jan-13	Remittance of Last Payment amounting to USD 75,000

